KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

TASK 250

HIDDEN LAKE SERVICE AREA REFINING WASTEWATER SERVICE ALTERNATIVES

HIDDEN LAKE SERVICE AREA
TASK 250: REFINING WASTEWATER SERVICE ALTERNATIVES

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INTRODUCTION

This report presents refined alternatives carried forward from the Task 240 report and a number of new alternatives for improving wastewater service for King County's Hidden Lake Pump Station/Boeing Creek Trunk system (Figure 1). This report also summarizes a workshop that was held with the consultant team and King County Wastewater Treatment Division (KC WTD) staff to reach agreement on a working alternative to pass to the WTD Capital Improvement Projects section to implement. The report is arranged roughly in chronological order and describes each of the major activities that have been undertaken since the preparation of the Hidden Lake Pump Station/Boeing Creek Trunk Task 240 report. The report contains the following sections:

- Part I: The results of the Task 240 project team meeting. This meeting was held in August 1999 to discuss the alternatives developed in the Task 240 report and to decide which of the alternatives should be given further consideration.

- Part II: The updated flow projections for the Hidden Lake Service Area[1] (Service Area) in the northwest part of King County. After the Task 240 report had been prepared, KC WTD received flow monitoring data collected by the Shoreline Wastewater Management District (WMD) upstream of the Hidden Lake Pump Station. KC WTD incorporated the data to update peak flow projections.

- Part III: The potential for infiltration and inflow (I/I) reduction in the Hidden Lake Service Area and the potential effects of I/I reduction on the sizing of new facilities.

- Part IV: The evaluation of five additional system alternatives that were identified during the December 1999 CSI project team meeting.

- Part V: A synopsis of the March 2000 Task 250 decision workshop, and a description of the working alternative.

This report also includes a number of appendices. Appendix A contains an environmental review of Alternative C (diversion pump station and sewer) and Alternative D3 (waterfront sewer). Appendix B contains the summary memo prepared after the Task 250 decision workshop, and Appendix C contains copies of the decision workshop presentation slides.

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[1] The Service Area includes all sewered areas that drain to the KC WTD Hidden Lake Pump Station. Because the operations and potential changes to the Hidden Lake Pump Station affect downstream facilities, the Service Area also includes downstream neighborhoods that drain to the Richmond Beach Pump Station. The extent of the Service Area is shown in Figure 1.

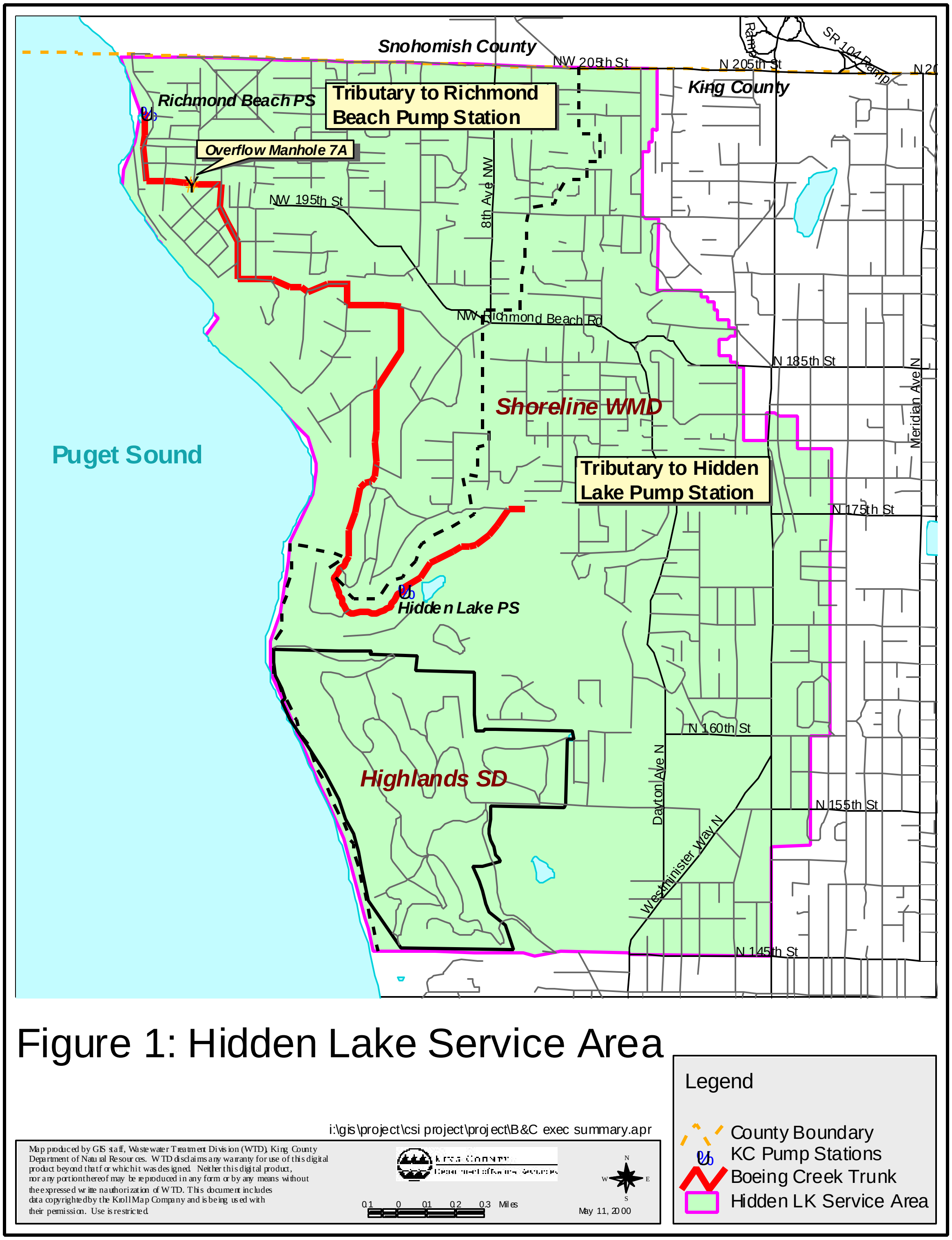


Figure 1: Hidden Lake Service Area

PART I: REVIEW OF TASK 240 PROJECT TEAM MEETING

The CSI project team and KC WTD staff met on August 19, 1999, to discuss which of the alternatives proposed in the Task 240 report were suitable and merited further investigation, and which alternatives should be dropped from further consideration. The Task 240 report contains complete descriptions of the service alternatives that are only briefly discussed herein.

The team meeting participants discussed each alternative in the Task 240 report. All agreed that paralleling the Boeing Creek Trunk (Alternative A) or incorporating tank storage into the system (Alternatives B1 and B2) would not be the best choices. Based on previous experience, County staff were concerned with the difficulties associated with constructing a parallel sewer through the Innis Arden neighborhood due to the number of buried utilities. KC staff also raised operations and maintenance concerns regarding storage. The preliminary cost estimates for Alternatives A and B were also higher than the Alternative C.

The consensus was that Alternative C2 was the most feasible alternative. Alternative C2 would include an 11.8 mgd pump station located near manhole B00-49 to pump wastewater northward towards the Edmonds Wastewater Treatment Plant. A gravity sewer would extend from the force main discharge (near the Snohomish County boundary) to the Richmond Beach – Edmonds Interceptor, intersecting at manhole 32A, for conveyance to the plant.

A set of alternatives that was described but not fully developed was included in Task 240 for completeness. These extra alternatives are collectively referred to as Alternative D. They include diverting flows to the Lake Ballinger Pump Station (Alternative D1), to the North Lake City Trunk (Alternative D2), to a new pressure sewer that would run along the City of Shoreline waterfront to the Richmond Beach Pump Station (Alternative D3), and westward to a new tunnel under to be constructed NW 175th Street (Alternative D4). Alternatives D1, D2, and D4 were not viable solutions. Alternatives D1 and D2 would redirect peak wet weather flows into sections of the KC WTD conveyance system that already have conveyance capacity limitations. The number of turns that would be required for a tunnel and the potential inconvenience to local residents caused by receiving pits were noted shortcomings of Alternative D4.

There are hydraulic advantages of constructing a sewer along the waterfront (Alternative D3). Despite the hydraulic advantages, team members were concerned with the potential environmental impacts of this option and were unsure whether this alternative was truly viable. Concerns included permitting challenges, damage to wetlands, and the stability of the bluff overlooking the proposed pipe alignment.

At the close of the meeting, the CSI project team decided that Alternatives A, B, D1, D2 and D4 would be eliminated from further consideration. Alternatives C (diversion pump station and sewer) and D3 (waterfront sewer) would be carried into Task 250 so that an environmental review of each could be performed. The review found numerous permitting, ESA, and construction problems with Alternative D3, leading the project team to eliminate this alternative from further consideration. See Appendix A for the results of the environmental review.

PART II: UPDATED FLOW PROJECTIONS FOR THE SERVICE AREA

The capacity analysis performed for the Task 240 report was based upon flow projections provided by KC WTD. When the Task 240 report was prepared, there was a lack of available local flow data for the local Service Area basins. KC WTD used observed flows at the Richmond Beach Pump Station along with a more extensive set of flow data from the Lake Ballinger Pump Station. The frequency of overflows upstream of the Richmond Beach Pump Station prevented the gauge at Richmond Beach from recording the full range of flow conditions, making the use of Lake Ballinger Pump Station flow data necessary. After observing the similar rainfall-derived I/I response at the Richmond Beach and Lake Ballinger flow monitors for storms small enough to not produce an overflow, KC WTD was able to assume a hydrologic similarity between the two basins to calibrate its I/I model and generate flow projections.

Differing ages of construction, anecdotal evidence, and previous Shoreline Wastewater Management District (WMD) I/I investigations all suggest that infiltration and inflow enter the collection system in varying quantities throughout the Service Area. Nonetheless, because only one flow monitor within the Service Area was used for the I/I model calibration, a uniform I/I generation rate was assumed for the entire Service Area.

After the preparation of the Task 240 report, KC WTD obtained and analyzed additional flow monitoring data collected by the Shoreline WMD within Basin 14, upstream of the Hidden Lake Pump Station (Table 1, Figure 2). The new flow data show that Basin 14 has higher peak I/I flows that previously assumed. However, the data do not give any indication whether previous I/I estimates for basins downstream of the Hidden Lake Pump Station were accurate or complete.

Table 1. Sub-Basin flow - tributary to Hidden Lake Pump Station[a]

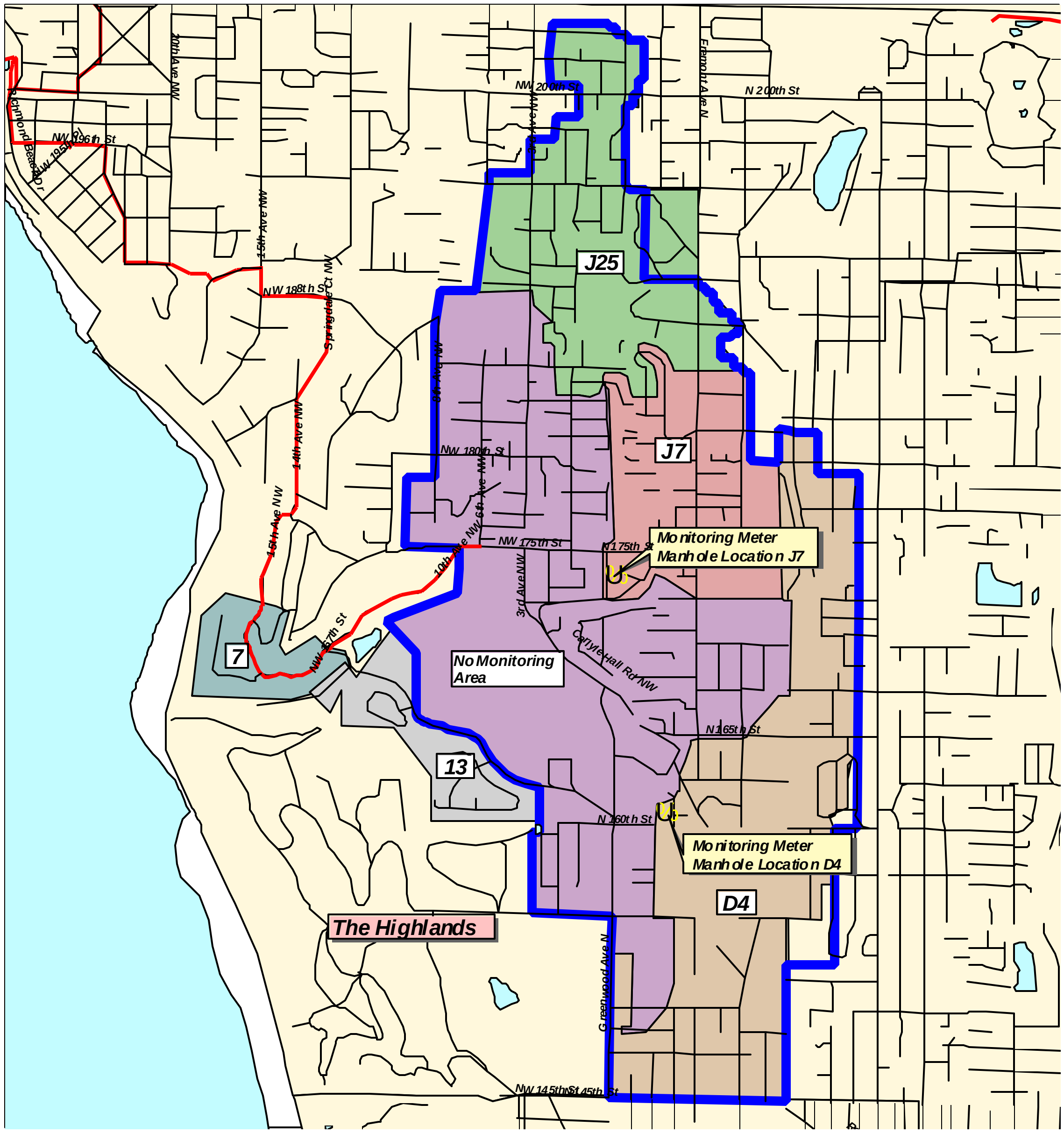
Basin	Area (ac)	Base Flow (mgd)	5-yr I/I (gpad)	5-yr Peak Flow (mgd)	20-yr I/I (gpad)	20-yr Peak Flow (mgd)
J25[b]	200	0.10	5,340	1.17	7,780	1.66
J7 (lower)[b]	150	0.08	2,600	0.47	4,300	0.65
J7+J25[b]	350	0.18	4,100	1.61	6,290	2.38
D4[b]	350	0.35	6,810	2.72	9,240	3.56
Unmonitored Basin 14[c]	600	0.30	4,100	2.76	6,290	4.07
Basin 7 (unmonitored)[d]	50	0.01	N/A	0.26	N/A	0.26
HSD & Basin 13 (unmonitored)[d]	400	0.04	N/A	0.86	N/A	0.86
Totals:	**1,750**	**1.06**		**8.2**		**11.1**

a. Flow projections are based on values provided by KC WTD. The estimated sewered area is lower than in the Task 240 report, because some unsewered areas within Basin 14 (e.g. parks) were removed.

b. These sub-basins are contained in Shoreline WMD Basin 14 and have been flow monitored.

c. I/I flows for unmonitored areas are set equal to the J7+J25 I/I rates. The land use patterns for the unmonitored basins are more similar to those of sub-basins J7+J25 than sub-basin D4.

d. Peak flows are set equal to the capacity of Shoreline lift stations 4 and 5.



i:\gis\projects\csi projects\sub_basin_project.apr

Figure 2

Hidden Lake PS Portable Monitors

Map produced by GIS staff, Wastewater Treatment Division (WTD), King County Department of Natural Resources. WTD disclaims any warranty for use of this digital product beyond that for which it was designed. Neither this digital product, nor any portion thereof may be reproduced in any form or by any means without the expressed written authorization of WTD. This document includes data copyrighted by the Kroll Map Company and is being used with their permission. Use is restricted.

0.1 0 0.1 0.2 0.3 Miles

April 17, 2000

Legend
- Roads
- KC Conveyance Line
- Shoreline WMD Basin 14 Boundary
- Service Basins

The monitored sections of Basin 14 have higher peak I/I rates than the Service Area average of 4,710 gpad for the 20-year peak (see Task 240 report, Table 2, year 2000 flow estimates). Because not all sections of Basin 14 were isolated by flow monitoring, some basins were assigned I/I rates based on neighboring sub-basins with similar land use patterns. Table 2 gives a new estimate of the 20-year peak flow at the Hidden Lake Pump Station by summing the peak flows from the individual sub-basins.

Shoreline WMD Basins 1 and 2, located near the Richmond Beach Pump Station, are also high I/I areas. The sewers in these basins are among the oldest in the Service Area and published Shoreline WMD data show a strong hydrograph response to rainfall. The time-series flow data were not available for this study, so the 20-year peak flow for these basins has not been estimated.

Table 2. Comparing peak flows at the Hidden Lake Pump Station

Source	5-Year Peak Flow (mgd)		20-Year Peak Flow (mgd)	
	Year 2000	Year 2050	Year 2000	Year 2050
Task 240 Flows [a]	8.2	9.7	9.9	11.8
Updated Flows	8.2 [b]	9.7 [c]	11.1 [b]	13.2 [c]

a. Data from Task 240 report, Table 1.

b. Flows are summed from Task 250 report, Table 1.

c. Task 250 flow projections for 2050 assume base flow and I/I increase at the rate established in Task 240.

These updated flow projections would not change the conclusions reached by participants at the Task 240 meeting, regarding Alternatives A and B. The basic layout of these two alternatives would not change, but larger facilities than those proposed in Task 240 would be necessary. Construction of larger facilities would increase costs, and the construction difficulties, and operations and maintenance issues discussed in the Task 240 project team meeting would still be a concern. Alternatives A and B are still considered less feasible than Alternative C and not subject to further analysis.

Alternative C would divert wastewater upstream of the Hidden Lake Pump Station under peak wet weather conditions to a new pump station and force main to limit flows through existing facilities and reduce the number of overflows at the Hidden Lake Pump Station and manhole 7A. The diversion pump station would be run intermittently throughout the wet season; KC WTD staff would develop the procedure by which the station would operate. Alternative C would also route wastewater generated downstream of the Hidden Lake Pump Station through existing facilities with no capacity upgrades.

Accurate flow projections upstream of Hidden Lake are necessary for sizing the new facilities. Accurate flow projections downstream of Hidden Lake are also necessary to verify the adequacy of existing facilities, under both low flow and high flow conditions. To summarize, prior to final design, the following assumptions should be verified by collecting additional flow monitoring data:

1. After diverting all wastewater upstream of the Hidden Lake Pump Station, there would be sufficient capacity in the Boeing Creek Trunk to convey the remainder of the 20-year peak flow.

2. Under low flow conditions, there would be adequate flow to limit deposition of solids along the Boeing Creek Trunk. Particular attention should be given to the hydraulics of the inverted siphon (forebay at manhole B00-29). KC operations staff indicated the Hidden Lake Pump Station will need to be replaced with an updated pump station, regardless of capacity issues. Designing the new Hidden Lake Pump Station with bidirectional pumping ability should meet low flow requirements in the Boeing Creek Trunk (e.g. the Hidden Lake Pump Station would discharge to the diversion pump station during peak storm events and to the Boeing Creek Trunk during dry weather).

3. The proposed new pump station located near manhole B00-49 should have a pumping capacity sufficient to pass the 20-year peak flow. Previous estimates placed the 20-year peak flow at 11.8 mgd. KC WTD's analysis of additional flow data suggests the 20 year peak flow would reach 13.2 mgd at the end of the planning window. This value must be verified or adjusted based on the results of additional Basin 14 flow monitoring conducted by KC WTD during the regional I/I program.

Refined Population Forecasts for the Service Area

This section contains refined KC WTD population forecasts for (1) the Service Area and (2) the area upstream of the Hidden Lake Pump Station. This section also includes comparisons of population forecasts developed for the *1999 Shoreline Comprehensive Plan* and the upcoming *Shoreline WMD Comprehensive Sewer Plan* (currently in draft form).

Population forecasts are important for projecting sanitary base flows. KC WTD assumes usage at 60 gpcd (gallons per capita per day) for residential, 35 gpcd for commercial and 75 gpcd for industrial users. Shoreline WMD uses 85 gpcd for residential users to cover all sanitary base flow. While the previous section (*Part II: Updated Flow Projections for the Service Area*) demonstrated that sanitary base flow comprises a small fraction of the 20-year peak flow and has little effect on facility sizing, sanitary base flow is important for defining low flows, which help determine the range of facility operations.

<u>Refined KC WTD Population Forecasts</u>

The population forecasts (residential, commercial, industrial) prepared in Task 240 were refined for the Task 250 report. In Task 240, KC WTD forecasts were based on the Puget Sound Regional Council's (PSRC) estimates for the Richmond Beach wastewater service basin, of which the Service Area comprises approximately 75 percent[2]. The Service Area forecasts were developed by multiplying the Richmond Beach wastewater service basin population data by this fraction, 75 percent. This method assumes that the distribution of population in the Richmond Beach wastewater service basin is representative of the Service Area.

In Task 250, the Service Area population forecasts were refined by using GIS analysis techniques to sum the population forecasts for the individual Traffic Analysis Zones (TAZ) that are contained in the Service Area[3]. The TAZ population data were provided by the PSRC[4]. The data source is the same as Task 240, but the analysis here is more detailed. These refined forecasts show that continued slow growth is expected throughout the 50-year planning window (Figure 3, Table 4).

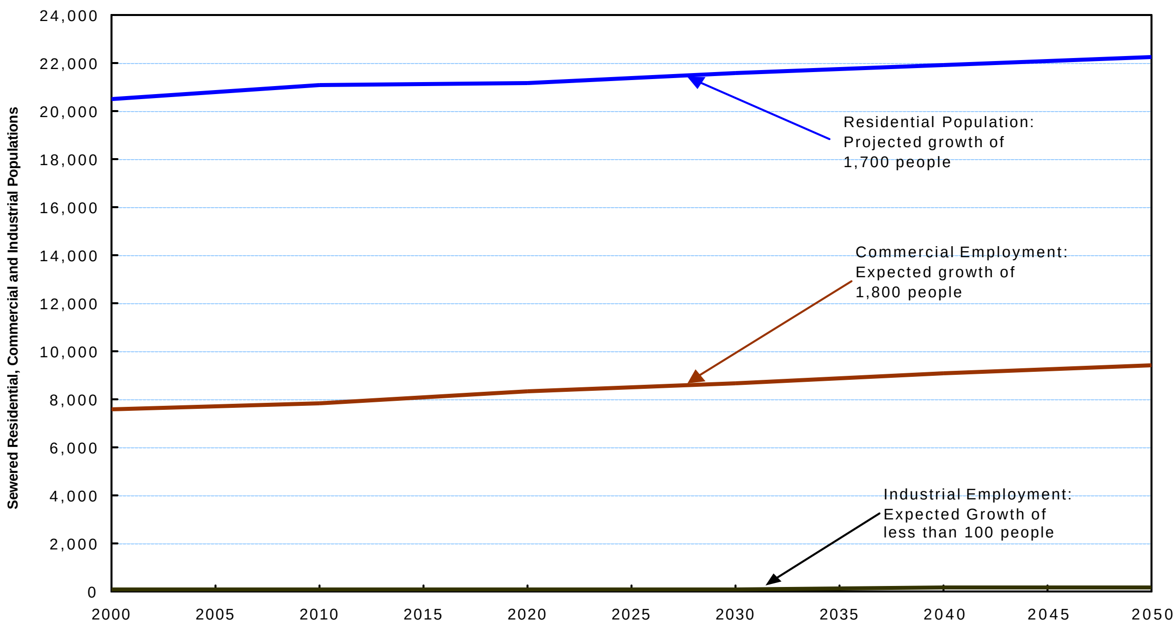


Figure 3. Refined residential population, commercial and industrial employment forecasts for the Service Area.

Population Forecast Comparison for Service Area

Revised population forecasts for the Service Area were derived from the *1999 Shoreline Comprehensive Plan* (*Shoreline Plan*) for comparison with KC WTD forecasts.

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[2] The Richmond Beach wastewater service basin differs from the Service Area by including areas of Shoreline that drain by gravity to the Lake Ballinger Pump Station.

[3] For TAZs that span the Service Area boundary, population is calculated (proportionately) according to the fraction of the TAZ within the Service Area

[4] Task 240 used wastewater basin-level forecasts while Task 250 used the more detailed TAZ-level population forecasts.

Appendix A of the *Shoreline Plan EIS* presents population forecasts for each of the neighborhoods in the City, for a 20-year window beginning in 1996[5]. The stated boundaries were used to determine which of the neighborhoods are located within the Service Area. Table 3 lists the city neighborhoods that fall within the Service Area along with baseline and forecasted residential populations, and Table 4 shows the KC WTD, *Shoreline Plan* and draft *Shoreline WMD Comprehensive Sewer Plan* population forecasts. In 2000, the *Shoreline Plan* forecasted residential population is 8 percent lower than the KC WTD forecasts. In 2016, the difference is one percent. The draft *Shoreline WMD* Comprehensive Sewer Plan residential population forecast is similar to the KC WTD forecast.

Table 3. Shoreline Comprehensive Plan residential population forecasts[a]

Neighborhood	Location	1996	2016
Richmond Beach	NW corner of city	4,661	5,345
Innis Arden	Western edge of city	1,284	1,303
The Highlands	SW corner of city	245	274
Hillwood	Northern edge of city; north of N. 185th St., west of Aurora Ave.	4,428	4,944
Richmond Highlands	Btw Aurora Ave. & Innis Arden E-W; Btw N. 165th St. & N. 185th St. N-S	4,512	4,990
Highland Terrace	East of Shoreline CC; bordered by Seattle Golf Club, Aurora Ave. and Westminster Way	2,436	2,916
Westminster Triangle	Southern edge of city along Westminster Way & Aurora Ave.	852	1,051
Total		**18,418**	**20,822**

a. These forecasts are for the entire Service Area: neighborhoods that drain to the Hidden Lake Pump Station and downstream neighborhoods served by the Richmond Beach Pump Station.

5 The population forecasts, which are reported in the *Shoreline Plan* in terms of dwelling units (DU), have been converted to residential population by assuming 2.4 residents per DU. This is the ratio of residents per DU used by the Shoreline WMD in its upcoming Comprehensive Sewer Plan. The City of Shoreline used PSRC's 1998 set of forecasts for its population and employment subarea forecasting.

Table 4. Refined population forecasts for Service Area[a]

Task 250: Refined KC WTD Forecasts (based on PSRC TAZ data, June 1999)			
Year	**Residential**	**Commercial[c]**	**Industrial[c]**
2000	20,483	7,572	66
2010	21,019	7,840	70
2016	21,098[b]	8129[b]	81[b]
2020	21,151	8,322	88
2030	21,549	8,664	99
2040	21,885	9,038	110
2050	22,218	9,413	120
Task 250: 1999 Shoreline Plan Forecasts			
Year	**Residential**	**Commercial**	**Industrial**
1996	18,418	N/A	N/A
2000	18,899[b]	N/A	N/A
2016	20,822	N/A	N/A
Task 250: Draft Shoreline WMD Comprehensive Sewer Plan Forecasts[d]			
Year	**Residential**	**Commercial**	**Industrial**
2000	19,919	N/A	N/A
2016	21,569	N/A	N/A
2020	21,981	N/A	N/A

a. These forecasts are for the entire Service Area: neighborhoods that drain to the Hidden Lake Pump Station and downstream neighborhoods served by the Richmond Beach Pump Station.

b. The reported residential population is linearly interpolated from previous and following time periods in order to provide easy comparison to the other forecasted data set.

c. KC WTD's commercial and industrial population is based on the PSRC's forecasting by U.S. Dept. of Labor Standard Industrial Classification (SIC) codes using Washington State Employment Security Department records.

d. The draft Shoreline WMD Comprehensive Sewer Plan dated May, 3, 2000, reported forecasted residential populations of 36,151 and 39,941 for 2000 and 2020 for the Shoreline WMD coverage area. The baseline population is based on the number of Residential Customer Equivalents (RCE) recorded by the District (2.4 people per RCE), and the growth rate is based on PSRC's 1995 TAZ study. The populations shown above have been computed using the fraction of the Service Area within Shoreline WMD coverage area (assumes uniform spatial population distribution), plus 245 residents for the Highlands (102 DU and 2.4 people per DU).

The Shoreline Plan also contains employment forecasts based on local economic development policies and land use policies for each TAZ in the planning area. The TAZ baseline data and 20-year commercial employment forecasts are presented in a series of tables in Appendix B of the *Shoreline Plan EIS*. The Shoreline Plan forecasts 4,635 additional jobs throughout the city during the 20-year planning period beginning in 1996.

Given the planned rezoning along Aurora Avenue to encourage higher density commercial construction, a significant fraction of the new commercial employment will occur in the Service Area.

Population Forecast Comparison for the Area Tributary to Hidden Lake Pump Station

Table 5 contains KC WTD, *Shoreline Plan*, and Shoreline WMD population forecasts for the area tributary to the Hidden Lake Pump Station[6]. The Shoreline WMD forecasts shown here are part of the District's upcoming Comprehensive Sewer Plan. The Shoreline WMD forecasted population in 2020 is 17 percent higher than the KC WTD forecast. *Shoreline Plan* forecasted populations higher than the KC WTD forecasts, but lower than the Shoreline WMD forecasts[7].

The differences among the forecasts could simply result from the different analysis techniques. The Shoreline WMD Comprehensive Sewer Plan (draft) states that four separate population forecasts[8] were available for the District to derive its forecasts, but none of the data sources matched up with the District's boundaries, and that a more detailed analysis would be necessary to determine the population served by Shoreline WMD. Similarly, the KC WTD forecasts rely on TAZs that are larger in extent than some of the sub-basins tributary to the Hidden Lake Pump Station. As a result, populations forecasted for smaller sub-basins do not include local distributions of population, but are computed based on the population density for a larger area. Additionally, the PSRC forecasts, from which the KC WTD data are derived, are more appropriate for long-term system development and facility sizing rather than near-term forecasting in very small subareas.

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[6] KC WTD population forecasts beyond 2020 are not included in Table 5 to make comparisons easier. See Table 4 for KC WTD forecasts beyond 2020.

[7] The Shoreline WMD Comprehensive Sewer Plan utilized PSRC's 1995 TAZ-level forecasts for population growth and its own recorded Residential Customer Equivalent (RCE) estimates for baseline population (2.4 people per RCE).

[8] Available forecasts: Washington State Office of Financial Management, the PSRC, the City of Lake Forest Park, the City of Shoreline (Phase II: 1998 TAZ-level study).

Table 5. Population forecasts for the Hidden Lake Pump Station tributary area[a]

Year	Residential	Commercial	Industrial
Refined KC WTD Forecasts (based on PSRC TAZ data)			
Year	**Residential**	**Commercial**	**Industrial**
2000	10,672	5,632	62
2010	10,954	5,821	66
2016	10,996[b]	6,014	77
2020	11,024	6,142	84
2030	11,230	6,375	92
2040	11,407	6,632	105
2050	11,578	6,887	114
1999 Shoreline Plan Forecasts[c]			
Year	**Residential**	**Commercial**	**Industrial**
1996	10,580	N/A	N/A
2000	10,870[b]	N/A	N/A
2016	12,028	N/A	N/A
Draft Shoreline WMD Comprehensive Sewer Plan Population Forecasts			
Year	**Residential**	**Commercial**	**Industrial**
1995	11,275	N/A	N/A
2000	11,603[b]	N/A	N/A
2016	12,652[b]	N/A	N/A
2020	12,914	N/A	N/A

a. These forecasts are for the neighborhoods that drain to the Hidden Lake Pump Station (Shoreline WMD Basins 7, 10, 13, and 14, and the Highlands SD).

b. The reported residential population is linearly interpolated from previous and following time periods in order to provide easy comparison to the other forecasted data set.

c. Based on an analysis of neighborhood boundaries and a Shoreline WMD drainage map, the following neighborhoods listed in the *Shoreline Plan* are considered tributary to the Hidden Lake Pump Station: Highland Terrace, Hillwood (50%), Innis Arden (25%), Richmond Highlands, The Highlands, and Westminster Triangle.

PART III: IMPACTS OF INFILTRATION AND INFLOW REDUCTION

This section contains a general discussion of the potential impacts of infiltration and inflow reduction for the Hidden Lake Service Area. This discussion is applicable to all of the conveyance improvement alternatives developed in the Task 240 memo.

Two I/I reduction schemes are examined:

1. A 30 percent basin-wide reduction in the peak 20-year I/I as a benchmark based on the goals of the KC regional I/I program.

2. A higher level of targeted I/I reduction for its effectiveness in limiting the number of new facilities to be constructed.

I/I Reduction in the Service Area

Infiltration and inflow account for about 86 percent of 5-year peak flow and 89 percent of the 20-year peak flow in the Service Area's wastewater conveyance system, based on the projections of the KC WTD calibrated I/I model (Table 6). During wet season storms, the existing conveyance facilities' capacities are periodically exceeded by I/I, resulting in sanitary sewer overflows (SSOs). According to KC WTD, there is currently an average of three SSO events each year[9] at the Hidden Lake Pump Station wet well, rather than the one event per 20 years KC standard. Hidden Lake Pump Station overflows are directed to Shoreline WMD Pump Station No. 4, where approximately 75 percent are controlled and pumped back to the Hidden Lake Pump Station. The other 25 percent of overflows discharge to Puget Sound. Downstream of the Hidden Lake Pump Station, there is a designed overflow at manhole 7A of the Boeing Creek Trunk and there have been reports of overflows at other manholes along the trunk (see Task 210 report).

Table 6. I/I Contribution to peak flows at the Richmond Beach Pump Station[a]

	Peak Flow (mgd)	I/I Flow (gpad)	I/I Flow (mgd)	% Attributable to I/I
5-Year Storm Event	15.2	4,530	13.0	86
20-Year Storm Event	19.9	6,160	17.7	89

a. The flow projections were provided by KC WTD for the year 2050. These estimates account for sewer deterioration by assuming a seven percent per decade increase in I/I for three decades through 2030. The updated flow projections from the previous section are incorporated upstream of Hidden Lake. The flow projections downstream of Hidden Lake were not updated because no new flow data were collected and analyzed for this part of the collection system.

<u>Basin-Wide 30 Percent I/I Reduction</u>

The Task 240 report described alternatives for conveying and/or storing the 20-year peak flow but did not address how I/I reduction could impact the size of facilities required for

[9] This estimate includes hydraulic capacity related overflows and overflows resulting from mechanical failures.

controlling SSOs. This section describes the benefits of I/I removal, using a 30 percent reduction in peak flow as a benchmark and provides preliminary cost information based on previous Brown and Caldwell projects. In addition, this section identifies field data acquisition to be considered during project predesign. The discussion here is general and applies to all alternatives described in Task 240.

Task 240 established that the capacity of the KC WTD pump stations and trunk sewer is substantially less than the projected 20-year peak flow in the Hidden Lake Service Area. Table 7 shows the projected 20-year peak flow at the Hidden Lake and Richmond Beach Pump Stations, and along the Boeing Creek Trunk without I/I reduction and following a 30 percent reduction of I/I.

Table 7. Impact of I/I reduction on existing facilities

Reach	Length (ft)	Design Flow[a] (mgd)	20-Year Peak Flow (mgd)	20-Year Peak Flow After 30% I/I Red. (mgd)	Excess Flow (mgd)[c]
B00-49 to HLPS	2,803	5.9	11.9	8.4	2.5
HLPS to B00-38	2,375	3.8[b]	13.2	9.2	5.4
B00-38 to B00-29	2,476	7.4	14.3	10.0	2.6
B00-29 to B00-23	3,316	5.5	14.9	10.4	4.9
B00-23 to B00-17	2,260	6.1	18.2	12.7	6.6
B00-17 to B00-04	3,718	9.6	19.1	13.4	3.8
B00-04 to RBPS	872	7.8	19.9	13.9	6.1
RBPS	N/A	10.4	19.9	13.9	3.5

a. Design flow calculated with Manning's equation using friction factor, n = 0.013

b. Equal to the pumping capacity of the Hidden Lake Pump Station.

c. Excess flow after 30 percent I/I reduction.

Removing 30 percent of the peak wet weather I/I would help reduce the frequency of overflows, but I/I model projections show that SSOs would still occur an average of once per winter. To meet the KC standard of one overflow per 20 years, new facilities would be required in addition to a 30 percent reduction in I/I.

<u>Attempting a Higher Level of I/I Reduction</u>

A more ambitious I/I control program could be instituted in an effort to avoid constructing new facilities and/or adding capacity to existing facilities. Table 8 shows the design capacity and projected 20-year flow in specific reaches of the Boeing Creek Trunk, similar to Table 7. Table 8 also shows the fraction of I/I that would need to be removed in order to limit the 20-year peak flow to the existing capacity of the conveyance system. The amount of I/I removal needed to eliminate excess SSOs is generally higher than 50 percent and as high as 71 percent for one reach[10].

Table 8. No capacity upgrades–I/I removal target

Reach	Length (ft)	Design Flow[a] (mgd)	20-Year Peak Flow (mgd)	% Removal Requred	I/I Rate Remaining (gpad)
B00-49 to HLPS	2,803	5.9	11.9	50	3,867
HLPS to B00-38	2,375	3.8[b]	13.2	71	1,404
B00-38 to B00-29	2,476	7.4	14.3	48	3,028
B00-29 to B00-23	3,316	5.5	14.9	63	1,947
B00-23 to B00-17	2,260	6.1	18.2	66	1,674
B00-17 to B00-04	3,718	9.6	19.1	50	2,819
B00-04 to RBPS	872	7.8	19.9	61	2,041
RBPS	N/A	10.4	19.9	48	2,946

a. Design flow calculated with Manning's equation with friction factor, n = 0.013

b. Equal to the pumping capacity of the Hidden Lake Pump Station.

An I/I control plan for the Service Area could also include roof and foundation drain disconnection, catch basin interconnection removal, manhole rehabilitation and sewer main rehabilitation. An accurate estimate of the costs of this level of rehabilitation cannot be developed without extensive flow monitoring, source detection, and the development of unit costs for I/I removal.

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10 The significance of the removal estimates in Table 7 can be understood by comparison with a previous I/I rehabilitation project performed by the Lacey, Olympia, Tumwater, Thurston County (LOTT) Wastewater Partnership *(LOTT Basin OL22 I/I Removal Effectiveness Evaluation Memorandum*; Brown and Caldwell, 1999). During the summer of 1997, the City of Olympia completed a rehabilitation of manholes and sewers located in the public right-of-way in the 130-acre, LOTT Basin OL22. A total of 18.2 inch-diameter miles of sewer mains (63 percent of basin total) and 195 lower side sewers from the sewer main to the property line (73 percent of basin total) were replaced. The results of flow monitoring and analysis using hydrologic simulations indicated only a 17 percent drop in the 20-year peak flow. If rehabilitation in the public right-of-way within the Hidden Lake Service Area yielded a similar 17 percent reduction in the 20-year peak flow, the peak storm flows would still be greater than the conveyance system capacity.

The LOTT results are supported by the finding in the *Bryn Mawr Infiltration/Inflow Field Investigation and Project Identification Study* (Brown and Caldwell, 1998) that the majority of peak I/I enters the conveyance system through connections or sewer defects on private property. The costs associated with I/I removal from private property would be substantial. There are approximately 5,000 private sewer connections in the Hidden Lake Service Area. The low-bid contractor for the Bryn Mawr Project estimated a cost of $7,000 per household for side-sewer replacement from the house connection to the sewer main (including surface restoration).

Much of the necessary I/I reduction activity would occur on private property and would probably require adopting and enforcing a municipal ordinance. The responsibility for any I/I prevention ordinances falls on the local sewer agencies: the Shoreline Wastewater Management District and the Highlands Sewer District. Private lateral sewer replacement and foundation drain disconnection would involve digging up property owners' landscaping to install new piping. The County is currently working with these agencies as part of the King County Regional I/I Control Project to assess the amount of I/I, select pilot projects to evaluate I/I control measures, and develop an equitable regional program to reduce I/I.

Rehabilitating a large enough portion of Service Area sewers to avoid all facility upgrades would cost more than building new facilities to convey the 20-year peak flow. However, targeted I/I reduction could be used in combination with other control strategies to delay and/or reduce the size of new facilities. Where appropriate, the alternatives described in the following section include an evaluation of targeted I/I reduction.

PART IV: EVALUATION OF ADDITIONAL ALTERNATIVES

In previous CSI project team meetings, there had been a clear preference for Alternative C2 (diversion pump station and sewer) over the other alternatives developed for Task 240. However, in a meeting held on December 2, 1999, County staff felt all possible improvements had not been examined. Given the level of capital expenditure necessary to control overflows in the Service Area, the feasibility of additional alternatives was to be measured against Alternative C2. There was also direction to examine a phased project implementation that could successfully coordinate with ongoing King County projects in the area, and level capital costs. This section contains an evaluation of the feasibility of five additional alternatives that were identified by the CSI project team and other KC staff.

Alternative D5. Using Primary Clarifiers for Storage at the Richmond Beach Pump Station

The consultant team was instructed to examine the feasibility of a variation on Alternative B2 that would use the abandoned (and currently filled in) primary clarifiers at the former Richmond Beach Treatment Plant for storage. A total storage volume of 1.5 MG would be required at this location, and if a large enough portion of the storage were provided by the clarifiers, there could be a significant cost savings. According to KC WTD personnel, the clarifiers were not dismantled during the Richmond Beach Flow Transfer Project, although the top few feet of the vertical walls were probably damaged.

In order to provide a significant cost savings, the clarifiers would need to:

- Remain structurally sound and capable of storing sewage after excavation.
- Provide a large enough fraction of the required storage at a low enough cost to make this alternative significantly less costly than the Richmond Beach storage alternative evaluated in Task 240 (Alternative B2).

The dimensions of the two rectangular clarifiers were given in Table 4-2 of the *Richmond Beach Treatment Plant Secondary Treatment Facilities Predesign Report* (May, 1987) and are reproduced here in Table 9.

Table 9. Dimensions of Richmond Beach Treatment Plant primary clarifiers

Length	95.67 ft
Width	16.5 ft
Average Depth	8.5 ft
Number of Clarifiers	2
Total Volume of Two Clarifiers	**200,743 gal**

Because the clarifiers could only provide a small fraction of the 1.5 MG storage required, Alternative D5 has no significant advantages over the alternative on which it is based, Alternative B2. Part I of this report detailed the shortcomings of Alternative B2. Since Alternative D5 does not resolve the previously noted problems with storage at the Richmond Beach Pump Station (see Part I: Review of Task 240 Project Team Meeting), it is not a feasible solution.

Alternative D6. Redirecting Part of Shoreline WMD Basin 14, Reducing Size of New Pump Station

Alternative C proposed to build a new pump station and force main to convey the wastewater generated in Shoreline WMD Basin 14 to the north and out of the Hidden Lake Service Area. Alternative D6 is similar to Alternative C, the key difference being a change to the piping alignment that reduces the size of the new pump station and force main.

The change in piping alignment would occur in the northern portion of Shoreline WMD Basin 14. Presently this area drains southward by gravity to the upstream end of the Boeing Creek Trunk (where the new pump station would be located). Alternative D6 would redirect a portion of the local collection system to connect with the new force main at the gravity transition point. This would reduce the required pumping capacity of the new pump station and size of the force main, resulting in a potential cost savings on these facilities.

The most likely scenario would divert wastewater from Shoreline WMD manhole DK1 (Richmond Beach Road, 300 ft east of 1st Avenue NW) westward to 8th Avenue NW. The diversion pipe would discharge into a force main to gravity transition manhole at Richmond Beach Road and 8th Avenue NW. A gravity sewer would carry wastewater to the north and out of the basin.

Manhole DK1 is located a short distance upstream of flow monitoring manhole J25. There are only a couple of streets that drain to J25, but not DK1, so the flow estimates for J25 are a good indication of flow at DK1. The current estimated 20-year flow for J25 is 1.66 mgd (see Table 2). Therefore, any diversion could be expected to reduce the wastewater flow at the new pump station by a similar amount.

The feasibility of this alternative has been examined using a map of local agency sewers and the best topographic data available. To support this evaluation, the KC WTD GIS group prepared a set of 2 ft contours, based on a digital elevation model (DEM) with 10 meter by 10 meter pixels[11].

An examination of the contour map shows that the local topography varies along the proposed diversion route, so that portions of a gravity sewer would need to be constructed relatively deep. The following describe the two sections of the proposed pipe:

- The section of Richmond Beach Road between manhole DK1 and 8th Avenue NW rises from an elevation of 395 ft to 421 ft between 2nd and 3rd Avenues NW, before dropping to an elevation of 393 ft at Richmond Beach Road and 8th Avenue NW. In order to flow by gravity, the diversion sewer would need to reach of maximum depth of more than 25 ft below the ground surface. While open-trench construction to a depth of 25 feet is technically feasible, it is more challenging and expensive than shallower open-trench pipeline construction. As an alternative to open-trench construction, a directional drill could potentially be used to construct a small-radius tunnel over the 2,000 ft distance between manhole DK1 and 8th Avenue NW. If this alternative were preferred, the more appropriate construction technique for the diversion sewer could be determined after a detailed analysis of construction issues and costs in predesign.

- The ridge line delineating the northern boundary of the Service Area crosses 8th Avenue NW near NW 200th Street. The ground surface slopes gently upward from an elevation of 393 ft at the proposed force main to gravity transition point to 424 ft at the ridge line. Beyond the ridge line, the ground surface slopes downward to the north. The maximum depth of a gravity sewer would preclude this use of open-trench construction on this section of pipe as well. A directionally drilled tunnel would need to be between 5,500 and 6,000 feet long for gravity flow beyond the ridge line and out of the Service Area.

[11] The DEM was prepared by the US Geological Survey. It has an absolute vertical accuracy of 7 m, but the relative (i.e. pixel-to-pixel) vertical accuracy is much higher.

This alternative should be considered only if it could be combined with other mitigation strategies to eliminate the need for a new pump station.

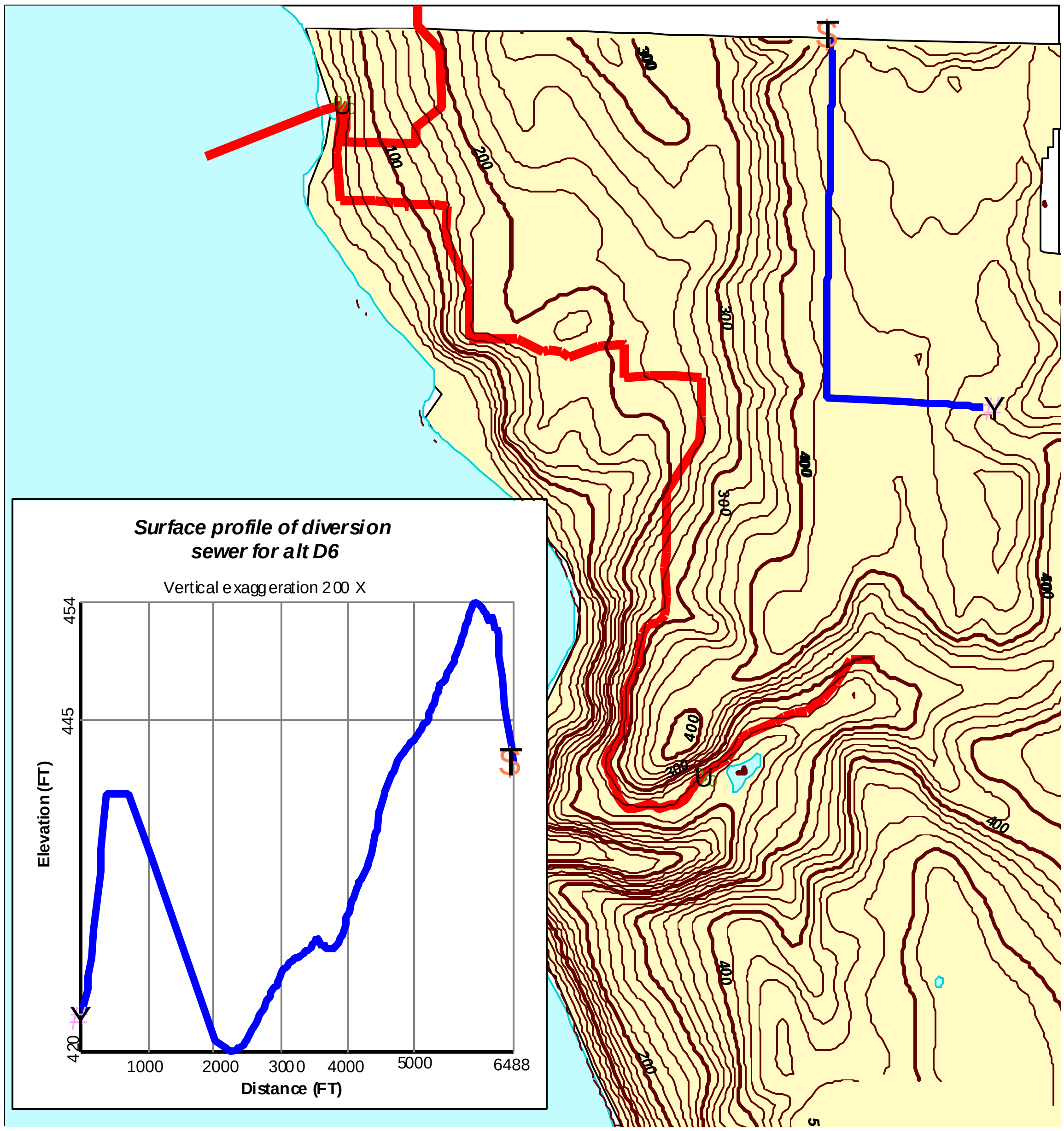

Figure 4: Alternative D6
Route and Surface Topography for Diversion Sewer

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Legend
- Diversion Sewer
- KC Pump Stations
- KC Conveyance Lines
- Hidden Lake Study Area

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January 28, 2000

Alternative D7. Tunnel storage and conveyance

Alternative D7 proposed to construct a 10 to 14-foot diameter tunnel from either manhole B00-49 or the Hidden Lake Pump Station to the Boeing Creek Trunk in the vicinity of the inverted siphon forebay (B00-29). The tunnel would allow enough storage to control the 20-year design storm at the Hidden Lake Pump Station. The outlet of the tunnel would be regulated to limit overflows downstream of its connection with the Boeing Creek Trunk.

A quick evaluation of the proposed routes showed that the Hidden Lake Pump Station elevation is lower than the proposed outlet at B00-29. This route is therefore not possible without pumping, and is not considered further. The elevation difference between manholes B00-49 and B00-29 is sufficient for gravity flow.

Constructing a tunnel solely in the public right-of-way would not be possible in this area, because tunneling machines have large turning radii (~900 feet), and would not be able to follow the turns of the winding, local streets. A number of access shafts could be dug to allow the tunneling machine to be lifted out and reoriented, but the depth of the tunnel (> 100 ft) and the density of local housing would make this option unacceptable.

The tunnel would have to be routed under more than a dozen private properties. The County would need to acquire easements from property owners prior to tunnel construction[12]. As the number of required easements increases, further evaluation of the potential risks would have to be performed. The feasibility of this alternative will depend in large part on the construction costs, technical challenges, and the anticipated difficulties associated with obtaining easements for tunnel construction under private property.

Table 10 lists the construction and project costs associated with two recent KC tunneling projects: the West Seattle Tunnel (bid 1994) and the Denny Way/Lake Union CSO Control Project (bid 1999). The costs of the West Seattle Tunnel are scaled up from a mid-1994 Engineering News Record (ENR) Seattle Construction Cost Index of 5,650 to the value of 7,000 that was used in Task 240.

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[12] Although tunneling easements under private property are more difficult and costly to obtain, easements were obtained for two properties prior to construction of the King County WTD West Seattle Tunnel. The tunnel was constructed under a corner of each property, well away from the houses. Settlement monitors were installed prior to and after construction and no ground settling was observed.

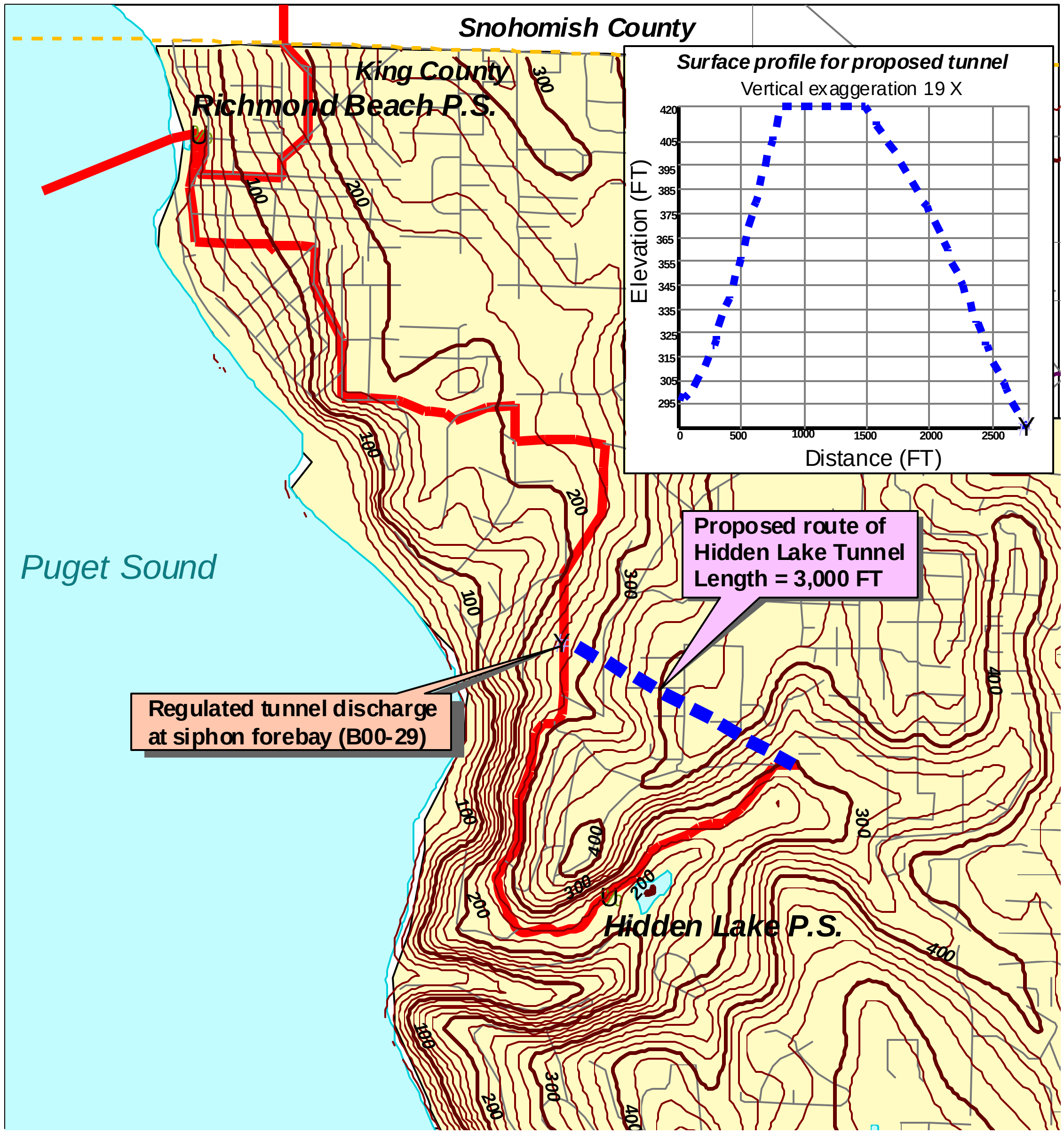

Figure 5: Alternative D7

Hidden Lake Storage Conveyance Tunnel

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Legend

- Siphon Forebay B00-29
- County Boundary
- Contour Lines
- Streets
- KC Pump Stations
- KC Conveyance Lines
- Hidden Lake Study Area

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February 3, 2000

Table 10. Construction and project costs for King County tunneling projects

	West Seattle Tunnel[a]	Denny Way/Lake Union Tunnel
Length	10,200 ft	6,200 ft
Diameter	13.1 ft	14.7 ft
Construction Cost	**$27.3 million[b]**	**$29.3 million**
Mobilization/ Demobilization (10%)[c]	$2.7 million	$2.9 million
Design and Owner Management (35%)[c]	$9.5 million	$10.3 million
Total Project Cost[c]	**$39.5 million**	**$42.5 million**

a. The West Seattle tunnel required easements for construction under two properties (see footnote 5).

b. Original construction cost of $22 million was scaled up from 1994 to 1999 dollars to be consistent with the Task 240 report. ENR Seattle CCI (1994) = 5,650; ENR Seattle CCI (1999) = 7,000

c. Mobilization/demobilization, design and owner management costs were added to the construction cost to compute a total project cost. This is consistent with the cost estimates provided in the Task 240 report.

The Hidden Lake Tunnel would be approximately 3,000 feet in length. Assuming the Hidden Lake Tunnel would have a range in cost per foot to the West Seattle and the Denny Way/Lake Union Tunnel ($3,900 to $6,800), and if the cost of rebuilding the Hidden Lake Pump Station is included, Alternative D7 costs would be similar to the alternatives examined in Task 240.

There are more uncertainties in cost and construction challenges with tunnel sewers than with open-trench sewers. Since there would probably be very little cost and/or operations and maintenance savings over Alternative C2 (diversion pump station and sewer), this tunneling/storage alternative should only be considered further if there are other issues, policy or otherwise, that would make tunnels preferable.

Alternative D8. Short-Term Solutions to Reduce SSO Frequency Until the North Treatment Plant has been Sited

This alternative uses a combination of short-term remedies to reduce the number of system overflows in the Service Area. The level of SSO control would initially target the once in 2-years or 5-years peak flow. Then, after a site for the North Treatment Plant is chosen, a program of facilities improvements and/or I/I reduction would be enacted to meet the KC standard of one overflow per 20 years. By initially seeking short-term solutions to system overflows, this alternative would seek to maximize the use of existing facilities and delay constructing costly facilities that may be underutilized after the North Treatment Plant is in operation. The feasibility of this alternative will depend on whether suitable control measures can be adapted quickly and cost-effectively, and whether the short-term solutions provide long-term flexibility.

To coincide with the scheduled startup date for the North Treatment Plant, the planning horizon for this alternative is 2010, rather than 2050 as was used in other alternatives. An interim solution might include a combination of I/I reduction, inline storage, additional conveyance capacity, and treatment of SSO discharges. The reduction in peak flows required to control the 2- or 5- year peak flow was determined and is described in Table 11. The projected 5-year peak flow for 2010 is similar to the value for 2000 given in Table 1, but also includes additional base flow due to population growth and a 7 percent increase in I/I for sewer degradation through 2030.

A scenario for controlling the 2-year peak flow was developed to test the feasibility of enacting a short-term solution. The 2-year peak flow is 3.0 mgd higher than the current maximum pumping capacity of the Hidden Lake Pump Station. The 5-year peak flow is 4.4 mgd higher than the current maximum pumping capacity of the Hidden Lake Pump Station.

This excess flow at the Hidden Lake Pump Station would have to be removed either by storage or I/I reduction if downstream facilities upgrades are to be kept to a minimum. Regardless of the mitigation upstream of Hidden Lake, there are periodic overflows from Boeing Creek Trunk manhole 7A that would need to be addressed. Manhole 7A is downstream of the "buried utilities" area described in Task 240, so no known construction factors would complicate adding capacity to the trunk downstream of manhole 7A.

Table 11. Sub-Basin flow-tributary to Hidden Lake Pump Station for 2010[a]

Basin	Area (ac)	Base Flow (mgd)	2-yr I/I (gpad)	2-yr Peak Flow (mgd)	5-yr I/I (gpad)	5-yr Peak Flow (mgd)
J25[b]	200	0.10	4,000	0.90	5,340	1.17
J7 (lower)[b]	150	0.08	1,530	0.31	2,600	0.47
J7+J25[b]	350	0.18	2,940	1.21	4,100	1.61
D4[b]	350	0.36	5,460	2.27	6,810	2.73
Unmonitored Basin 14[c]	600	0.31	3,100	2.17	4,100	2.77
Basin 7 (unmonitored)[d]	50	0.01	N/A	0.26	N/A	0.26
HSD & Basin 13 (unmonitored)[d]	400	0.04	N/A	0.86	N/A	0.86
Totals:	**1,750**	**1.08**		**6.8**		**8.2**

a. Flow projections are based on values provided by KC WTD. The estimated sewered area is lower than in the Task 240 report, because some unsewered areas within Basin 14 (e.g. parks) were removed.

b. These sub-basins are contained in Shoreline WMD Basin 14 and have been flow monitored.

c. I/I flows for unmonitored areas are set equal to the sub-basin J7+J25 I/I rates. The land use patterns for the unmonitored basins are more similar to those of sub-basins J7+J25 than sub-basin D4.

d. Peak flows are set equal to the capacity of Shoreline lift stations 4 and 5.

Controlling the 2-Year Storm Until 2010 with I/I Reduction

If I/I reduction were used to reduce peak flows, the most cost-effective method of rehabilitation would be to concentrate on portions of the collection system with the highest I/I. Of the monitored portions of Shoreline WMD Basin 14, the highest I/I was measured at local manhole D4. The 2-year peak I/I is estimated at 5,460 gpad. Previous documented Brown and Caldwell experience suggests that rehabilitation including private lateral and sewer main replacement can reduce the peak I/I by up to 70 percent. Assuming a similar 70 percent reduction could be realized in the Service Area, the post-rehabilitation I/I upstream of manhole D4 would be reduced to 1,820 gpad, a reduction of 1.90 mgd. Approximately 600 acres of Basin 14 has not been isolated by flow monitoring. If we assume that half of this area has I/I rates similar to the sewers upstream of D4, an additional 1.1 mgd could be removed by full rehabilitation.

Rehabilitating the private and public sewers upstream of local manhole D4 and an additional 300 acres with similar I/I rates could reduce I/I enough to control the 2-year storm until the North Treatment Plant begins operation in 2010. The area tributary to D4 includes commercial and multifamily housing which are typically more expensive to rehabilitate per acre than single family residential areas[13]. Beyond this initial cost, there would be the additional expense of upgrading the conveyance system once the new treatment plant comes online, and extending the planning window out to 2050. In addition to the I/I reduction, the hydraulic constriction downstream of manhole 7A must be removed. A total of 2,000 feet of pipe would be replaced at an approximate cost of $1 million. As part of the phased approach, KC may also install an interim wet weather treatment device along the Hidden Lake Pump Station overflow line, such as a Continuous Deflective System (CDS) to reduce the volume of solids and floatables discharging to Puget Sound when overflows occur.

Controlling the 5-Year Storm Until 2010 with I/I Reduction

Reducing the peak 5-year flow to the capacity of the Hidden Lake Pump Station by I/I reduction would be more challenging than controlling the 2-year peak flow, and would require rehabilitation in a greater portion of the Service Area. Assuming that replacing lateral and main sewers would remove 70 percent of peak I/I, all of Basin 14 would require rehabilitation, with the exception of lower portion of the basin isolated by manhole J7 (see Figure 2). The rehabilitation would cover 1,500 acres. Since the majority of the rehabilitation would occur in residential areas, the per acre cost would probably be less than rehabilitating the area above manhole D4, which is primarily composed of commercial properties and mixed use housing. Assuming an average cost of $20,000 per acre, it would cost approximately $30 million to reduce the 5-year peak

[13] Previous documented Brown and Caldwell experience suggests than the sewer rehabilitation would cost approximately $25,000 per acre. Rehabilitating 650 acres would therefore cost approximately $16.25 million. These costs are based, in part, on Olympia costs for lateral sewer and main sewer replacement, and Bryn Mawr lateral replacement. The per acre cost of lateral replacement can be widely variable and depends on the number of connections per acre, and the amount of surface restoration required.

flow to the current capacity of the Hidden Lake Pump Station by rehabilitating sewers in Shoreline WMD Basin 14. Adding capacity downstream of manhole 7A would also be required. Given the cost of controlling the 2-year peak flow with I/I reduction alone, a phased project with this level of I/I control, plus additional conveyance facilities (similar in alignment but smaller in size than those in Alternative C) to control the 20-year peak flow, would be more costly than Alternative C2 (diversion pump station and sewer). Targeted I/I control, however, may form a part of a phased solution that would include storage and expanded conveyance facilities. This phased alternative would also serve to work toward compliance with KC policy objectives while maximizing the use of existing facilities.

<u>Controlling the 2-Year Storm with Inline Storage, or Inline Storage and I/I Reduction</u>

Limiting overflows to once per 2 years (until 2010) by I/I reduction alone would have significant costs. Another approach would utilize storage, possibly combined with I/I reduction. It is assumed that all storage would be inline, i.e. a large diameter pipe. Two scenarios are examined in this section.

1. Rehabilitate the 350 acres upstream of Shoreline manhole D4, and install 0.1 MG of inline storage to control the two-year storm. A combination of additional conveyance capacity, storage, and/or I/I removal would be required beyond 2010.

2. Construct a 0.5 MG inline storage pipe near manhole B00-49 to control the two year peak storm until 2010. Beyond 2010, a comprehensive solution would be required to meet the KC standard of one overflow every 20 years.

The combination of inline storage and I/I reduction evaluated consists of a 300 foot long section of 8 foot diameter pipe and rehabilitation of the 350 acres upstream of Shoreline manhole D4. A preliminary analysis of costs suggests the sewer rehabilitation costs would be approximately $8.75 million (assuming a cost of $25,000 per acre), and the storage pipe would be approximately $0.7 million. Adding additional capacity downstream of Boeing Creek Trunk manhole 7A and installing a Continuous Deflective System on the Hidden Lake overflow line would bring project costs close to $11 million. A number of new facilities would also be required after 2010 for a long-term solution to controlling system overflows to the KC standard.

The *storage only* solution could consist of a 1,500 foot long section of 8 foot diameter pipe. The upstream end of the Boeing Creek Trunk is a potential location for this pipe. Construction factors, such as the width of the street under which the pipe would be installed and impact of construction on local traffic, and the depth of the existing sewers, may affect the feasibility of the project. A preliminary analysis of piping and installation costs suggests the storage pipe would cost of between $3 and $3.5 million (project cost, ENR Seattle CCI 7000). Adding capacity downstream of manhole 7A and placing a Continuous Deflective System unit on the Hidden Lake overflow line would bring total project costs to approximately $5 million.

This interim solution would cost less than the I/I reduction scenarios above. The storage solution only controls the 2-year storm, and is only sufficient until 2010. Many of the same facilities proposed in Task 240 would be required for a long-term solution, if sufficient flow reduction is not obtained through the County's regional I/I control program.

Controlling the 5-Year Storm with Inline Storage, or Inline Storage and I/I Reduction

To control the 5-year peak flow until the North Plant is operating in 2010 requires reducing the peak flow at the Hidden Lake Pump Station from 8.2 mgd to 3.8 mgd. To accomplish this peak flow reduction by storage alone would require a tank or storage pipe with one million gallons of capacity. The planning level assessment of the area upstream of the Hidden Lake Pump Station suggests that 0.5 MG of storage could be accommodated in a gravity in/gravity out configuration. The feasibility of providing 1 MG of storage must be evaluated with further site investigations during project predesign. A preliminary estimate of offline storage costs ranges from $5.5 to $6.0 million (project cost, ENR Seattle CCI 7000), plus an additional $1.5 to $2.0 million for pipe improvements downstream of overflow manhole 7A and placing a Continuous Deflective System unit on the Hidden Lake Pump Station overflow line to capture floatables.

Assuming storage were limited to 0.5 MG, an additional 1.4 mgd of peak flow must be removed by I/I reduction. This could be accomplished by targeting 300 acres of the area upstream of local manhole D4 (see Figure 2 for location) for a 70 percent reduction in peak 5-year I/I (from 6,820 gpad to 2,050 gpad). Assuming the rehabilitation costs an average of $25,000 per acre (some residential and commercial land use), rehabilitating 300 acres costs $7.5 million. Together with storage, improvements downstream of overflow manhole 7A and floatables control on the Hidden Lake Pump Station overflow line, the total cost of this interim solution is estimated at $12.5 million

The phased solutions presented in this section are only a selection of possible strategies, and the costs presented are preliminary and subject to further investigation. Other combinations of I/I reduction, increased conveyance and storage could be developed for meeting the immediate goal of reducing SSOs in the Service Area, the long-term goal of meeting the KC standard of one overflow per 20 years, and providing the flexibility to adapt to the North Plant location and the results of the regional I/I study.

Alternative D9. Phasing Portions of Alternative C Construction on an As-Needed Basis

The evaluation of alternatives in Task 240 and previously in this document suggests Alternative C (diversion pump station and sewer) is a promising solution for meeting present and future wastewater conveyance needs in the Service Area. However, there are two major King County projects that will have an effect on Alternative C: the regional I/I program and the siting of the North Treatment Plant. This section examines the specific impacts these projects will have on Alternative C and whether cost savings may be realized by phasing elements of Alternative C construction without compromising the 20-year design standard.

Between winter 2000 and 2004, the KC regional I/I program will monitor local and regional system flows to assess I/I impacts on the King County conveyance system. A number of pilot I/I reduction projects will be conducted throughout the County during the project. Flow monitoring and analysis will help refine our understanding of I/I rates in the Service Area, and the pilot projects will refine our understanding of the effectiveness of I/I removal methods. The final report will be completed in 2004, at which time the conveyance system improvements for the Service Area would be designed. If this area were selected for one of the Regional I/I Control pilot projects, construction of a small representative rehabilitation project in the Service Area could be completed by winter 2002. The flow data collected during the regional I/I study will help provide greater confidence in the Service Area conveyance system design flows.

The location of the North Treatment Plant will affect the sizing or even the need for some of the conveyance facilities proposed in various alternatives. The following are examples of specific elements of Alternative C that may be impacted by the location of the new treatment plant.

- While most of the facilities proposed in Alternative C are required immediately, the additional capacity on the Richmond Beach - Edmonds Interceptor would not be needed until after 2010. If the North Treatment Plant is located at Point Wells or to the north of Lake Washington, the Richmond Beach - Edmonds Interceptor may not be needed. Construction along this interceptor could be avoided, resulting in a cost savings of between $1 and $2 million.

- The new pump station to be located near manhole B00-49 would house several pumps, and need an ultimate pumping capacity of 13.2 mgd, according to the updated flow projections. The station pump house should be constructed large enough for the ultimate flow, with pumps to be added on an as-needed basis.

- According to the current schedule, North Treatment Plant siting should be completed by the end of 2002. At that time, the Hidden Lake conveyance system improvements preliminary design will be completed, with final design not yet finished. Because Alternative C was designed to be flexible in response to the plant siting, the layout of the new force main/gravity sewer could be adjusted for cost savings after the plant is sited. If the treatment plant is sited prior to Hidden Lake design, adjustments could be made without disrupting the Hidden Lake schedule. Because of the frequency of overflows at the Hidden Lake Pump Station (either storm induced or mechanically caused), however, it is not recommended that the Hidden Lake Pump Station project be delayed.

PART V: REVIEW OF HIDDEN LAKE DECISION WORKSHOP AND DESCRIPTION OF THE WORKING ALTERNATIVE

The consultant team was instructed to prepare alternatives that involved phased construction and combinations of demand management, storage and increased conveyance. The additional phased/combination alternatives were presented to KC staff at a decision workshop held on March 16, 2000. The objective of the workshop was to specify a working alternative that would meet the immediate upgrade needs at the Hidden Lake Pump Station, reduce the number of sanitary overflows in the service area, and achieve the KC 20-year control level (see Appendix B for meeting notes; Appendix C for presentation slides).

The workshop began with a description of the current level-of-service problems in the Service Area, a review of future flow projections, and a recap of the alternatives that had been previously developed. Following the review of previous work, additional alternatives emerged by combining the following elements:

- Increasing the conveyance capacity along the existing corridor
- Incorporating storage to attenuate peak flows
- Managing demand by reducing I/I and/or reducing the amount of sewer deterioration
- Constructing a pump station and diversion sewer to carry peak flows away from the Boeing Creek Trunk

Working Alternative

The working alternative would initially retrofit or replace the Hidden Lake Pump Station to achieve a peak pumping capacity of 5.5 mgd, and parallel or replace a total of 6,400 lineal feet of the most capacity limited sections of the Boeing Creek Trunk[14]. Increasing the pumping capacity at Hidden Lake and removing the bottlenecks in the Boeing Creek Trunk would allow the full capacity of the 10.4 mgd Richmond Beach Pump Station to be used. This combination of upgrades would reduce the number of storm related overflows to approximately one every 2 years. Providing 0.5 MG of storage upstream of the Hidden Lake Pump Station would, according to the best available flow information, further reduce the number of storm related overflows to one every 4 to 5 years. After the North Plant siting and regional I/I programs are completed (assumed 2005), the level of control would be brought to the KC standard of one overflow every 20 years by I/I

[14] Increasing the capacity of the Hidden Lake Pump Station from 3.8 mgd to 5.5 mgd and upgrading the downstream conveyance brings the capacities of these facilities in line with the Richmond Beach Pump Station. Both upgrades are essential to reducing overflows until the 20-year control plan is implemented. Increasing the capacity of the trunk sewer will reduce overflows at manhole 7A. Rebuilding or retrofitting the Hidden Lake Pump Station with a 5.5 mgd capacity will reduce the frequency of overflows from the wet well, while limiting force main velocities to 8 ft/s. All facilities would have sufficient capacity for the unattenuated 2-year peak flow.

reduction, additional storage and/or construction of a diversion pump station and sewer directed away from the Boeing Creek Trunk. The final flow projections and treatment plant location would be used for sizing and alignment of the new facilities.

This alternative provides:

- Short-term improvements that will reduce the frequency of overflows and long-term improvements will incorporate better flow projections and routing information.
- Time for the regional I/I program to work. Rather than accepting all flows from the component agencies, the County can work with these agencies to promote I/I control and system maintenance to manage peak flows.
- Expanded capacity in the Boeing Creek Trunk that will allow the Richmond Beach Pump Station to be fully utilized.

The decision to retrofit the Hidden Lake Pump Station or replace it with an adjacent pump station (possibly where the driveway is currently located) will be made after performing a detailed analysis in project predesign. The predesign team must investigate if larger pumps that meet the new design head and flow conditions could fit within the existing layout, and if these pumps could pump slowly enough to pass dry weather flows with continuous operation (i.e. alleviate current cycling problem). New electrical, instrumentation and control equipment will be necessary whether retrofitting or replacing the station. The amount of work involved and the necessity of maintaining operation of the pump station during construction may require that the existing station to be replaced. The cost estimates prepared in this section assume the Hidden Lake Pump Station is replaced with a new pump station.

If a new station is built, the design team must work closely with KC operations and maintenance staff to avoid the major operating constraint of the current station. During low flow periods, the small size of the wet well and range of operation of the pumps cause the pumps to frequency cycle on and off. This problem could be minimized by incorporating storage in the influent portion of the Boeing Creek Trunk, and choosing pumps that can operate slowly enough to continuously pump dry weather low flows. The existing overflow/relief sewer orientation would also have to be changed. Currently, the wet well influent from Shoreline Pump Stations No. 4 and No. 5 also forms the wet well overflow (see Figure 6). Backflow into this line would have to be eliminated by either reorienting the piping or installing an appropriate valve. A new pump station overflow/relief sewer could be installed in the upstream piping. All local connections were previously removed from the Boeing Creek Trunk, so locating the relief structure upstream of the pump station will not affect service to local customers so long as the overflow piping is large enough to prevent backups beyond manhole B00-49.

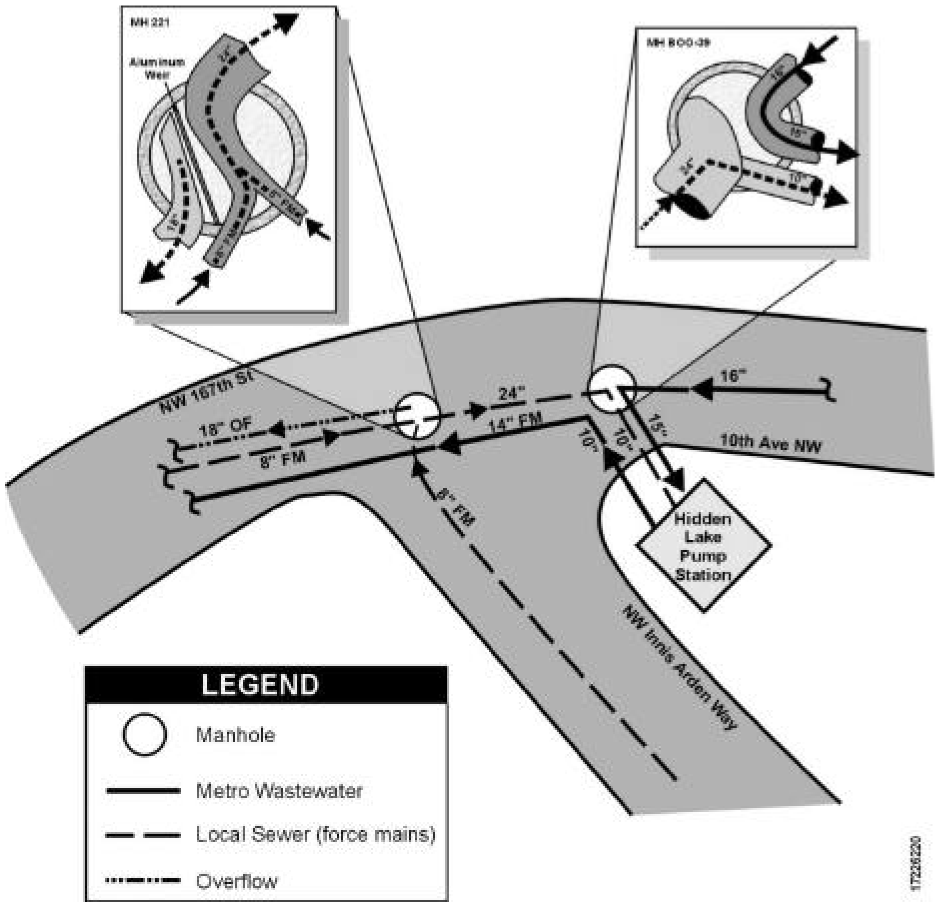

Figure 6. Influent, effluent and overflow piping in the vicinity of the Hidden Lake Pump Station

Figure 7 shows projected peak flows, current and pre-sliplining conveyance capacities along the Boeing Creek Trunk. The paralleling/replacement work is planned for the pipe segments between manholes B00-29 to B00-17 and B00-7 to the Richmond Beach Pump Station (see Figure 8 for replacement/parallel pipe locations). These pipes are shown in Figure 7 as not having enough capacity to pass the 2-year peak flow. Table 12 gives a list of previous and planned pipe rehabilitation work (including paralleling/replacement) for each segment of the Boeing Creek Trunk. Wherever it is feasible, the future rehabilitation work should be superseded by pipe replacement.

It should also be noted that other reaches of the Boeing Creek Trunk (B00-38 to B00-29 and downstream of B00-17) have estimated capacities that are close to the projected 2-year peak flow. Flow data have not been collected in this portion of the trunk (see *Part II: Updated Flow Projections for the Service Area*). The conveyance capacity of the Boeing Creek Trunk should be validated with a dynamic hydraulic model of the pipeline. If the peak flows in this section of the pipeline are higher than previously assumed, either additional pipe will need to be paralleled/replaced, or the level of control will be lower. Replacing additional sections of the trunk will increase costs.

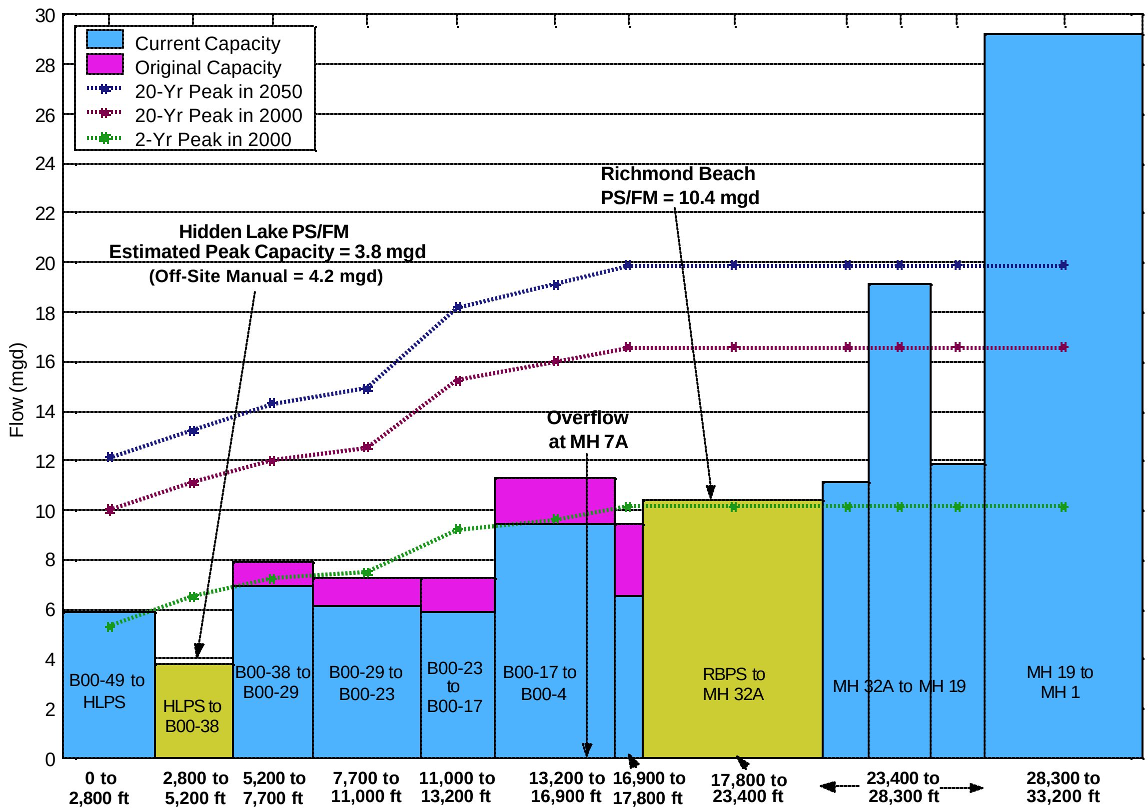

Figure 7. Peak flows and conveyance capacity in the Boeing Creek Trunk.

Table 12. Previous and planned work along the Boeing Creek Trunk

Upstream MH	Down-stream MH	Length (ft)	Diameter (in) [a]	Sliplined in 1988	Planned CIPP Rehab	Planned Parallel/ Replace	No past or planned work
B00-49	B00-48	305	24/15				✓
B00-48	B00-47	341	15				✓
B00-47	B00-46	258	15				✓
B00-46	B00-45	300	15				✓
B00-45	B00-44A	147	15				✓
B00-44A	B00-44	145	15				✓
B00-44	B00-43	246	15				✓
B00-43	B00-42	286	15				✓
B00-42	B00-41	123	15				✓
B00-41	B00-40	235	15				✓
B00-40	B00-39	357	16				✓
B00-39	HL PS	40 (est.)	16				✓
HL PS	B00-38	2375	14				✓
B00-38	B00-37	271	13.1	✓			
B00-37	B00-36A	125	15				✓
B00-36A	B00-36	48	18				✓
B00-36	B00-35	334	13.1	✓			
B00-35	B00-34	439	18				✓
B00-34	B00-33	126	18				✓
B00-33	B00-32A	141	18				✓
B00-32A	B00-32	112	18				✓
B00-32	B00-31	274	18				✓
B00-31	B00-30	327	18				✓
B00-30	B00-29	279	13.1	✓			
B00-29	B00-28	1820	8,16			✓	
B00-28	B00-27	233	15	✓		✓	
B00-27	B00-26	265	15	✓		✓	
B00-26	B00-25	333	13.1	✓		✓	

a. For the pipe sections that were sliplined in 1988, the inner diameter of the HDPE lining is given.

Table 12. Previous and planned work along the Boeing Creek Trunk (cont.)

Upstream MH	Down-stream MH	Length (ft)	Diameter (in) [a]	Sliplined in 1988	Planned CIPP Rehab	Planned Parallel/ Replace	No past or planned work
B00-25	B00-24	344	15	✓		✓	
B00-24	B00-23	319	13.1	✓		✓	
B00-23	B00-22A	15	15	✓		✓	
B00-22A	B00-22	382	15	✓		✓	
B00-22	B00-21	334	15	✓		✓	
B00-21	B00-20	407	18			✓	
B00-20	B00-19	132	18			✓	
B00-19	B00-18A	59	18			✓	
B00-18A	B00-18	175	18			✓	
B00-18	B00-17A	312	20.6	✓		✓	
B00-17A	B00-17	44	24			✓	
B00-17	B00-16	297	18				✓
B00-16	B00-15	282	13.1	✓			
B00-15	B00-14	337	15	✓			
B00-14	B00-13	348	15	✓			
B00-13	B00-12	333	15		✓		
B00-12	B00-11	252	13.1	✓			
B00-11	B00-10	427	18		✓	✓	
B00-10	B00-9	288	13.1	✓			
B00-9	B00-8	206	21		✓		
B00-8	B00-7	60	13.1	✓			
B00-7	B00-6	160	13.1	✓		✓	
B00-6	B00-5	280	15		✓	✓	
B00-5	B00-4	399	15		✓	✓	
B00-4	B00-3	337	18.7	✓		✓	
B00-3	B00-2	316	20.6	✓		✓	
B00-2	B00-1	214	20.6	✓		✓	

a. For the pipe sections that were sliplined in 1988, the inner diameter of the HDPE lining is given.

The CSI project team has performed a preliminary analysis of where the 0.5 MG of storage could be located. The relatively small, flat portion of the Hidden Lake Pump Station property would probably not be large enough to contain a 0.5 MG storage tank. If the new pump station is built adjacent to the existing pump station[15], the existing station's dry pit could be converted to storage after the new pump station is online, but this would only accomplish a small fraction of the 0.5 MG needed. One potential location for offline, gravity in/out storage is along NW 175th Street, between 6th and 10th Avenues NW. A storage tank and associated piping could be located on a section of the vacant property on the northwest corner of NW 175th Street and 6th Avenue NW. Alternatively, an 8-foot diameter offline pipe could be installed from B00-49 to B00-42 (Figure 8). This pipe would measure 1,450 feet in length and would contain approximately 0.5 MG of storage volume. These examples are included to illustrate that storage upstream of Hidden Lake is possible. The location and alignment of storage elements must be examined in greater detail during project predesign.

Table 13 shows cost estimates for both phases of the working alternative. The component costs shown for phase I of the project are Brown and Caldwell estimates and include 10 percent for contractor's operations and profit, 10 percent mobilization/demobilization, 30 percent contingency, 8.6 percent sales tax, and 35 percent for design. The phase II costs assume additional facilities are a diversion pump station and sewer sized to provide enough additional capacity to convey the 20-year peak flow (see Appendix C, slides 17-22).

[15] Building the new pump station adjacent to the existing pump station would allow the current station to continue operating during construction.

Table 13. Working Alternative cost estimate

	Cost (millions; ENR Seattle CCI =7,000)
Project Phase I:	
Replace Hidden Lake PS at 5.5 mgd	3.3[a]
Parallel/Replace 6,400 ft of Boeing Creek Trunk (brings control to 2-year level)	4.0[a,b]
Add 0.5 MG of storage upstream of Hidden Lake PS (brings control to 4 to 5-year level)	2.8[a]
Add KC allied costs (assume +50%)	+50%
Phase I Total	**15.1**
Project Phase II:	
Add facilities (brings control to 20-year level; KC allied costs included)[c]	20.5
Total Project Cost:	**35.6**

a. Brown and Caldwell estimates include 10% contractors O&P, 10% mob/demob, 30% contingency, 8.6% sales tax, and 35% for design. These costs assume the Hidden Lake Pump Station is replaced, not retrofitted.

b. Construction costs in the congested area downstream of the Hidden Lake Pump Station have been increased by 50% to reflect the potential difficulties of design and construction in areas with large numbers of buried utilities.

c. Assumes diversion pump station and sewer sized to bring control to 20-year level with no I/I reduction, and a 7% increase in I/I per decade for 3 decades through 2030.

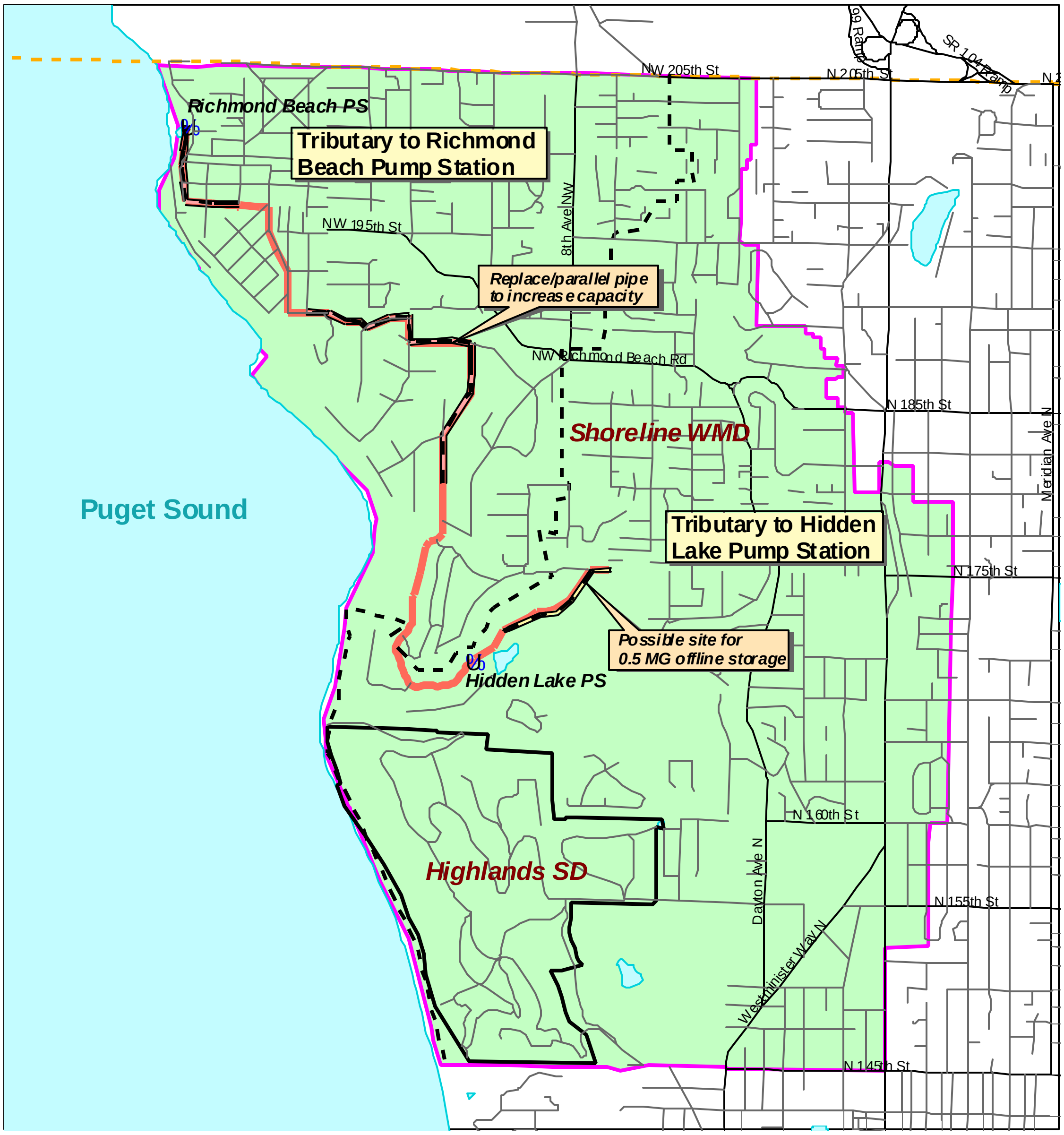

Figure 8: Working Alternative Phase I

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0.1 0 0.1 0.2 0.3 Miles

May 11, 2000

Legend
- Off-line storage pipe
- KC Pump Stations
- Sections to Replace/Parallel
- County Boundary
- Boeing Creek Trunk
- Hidden LK Service Area

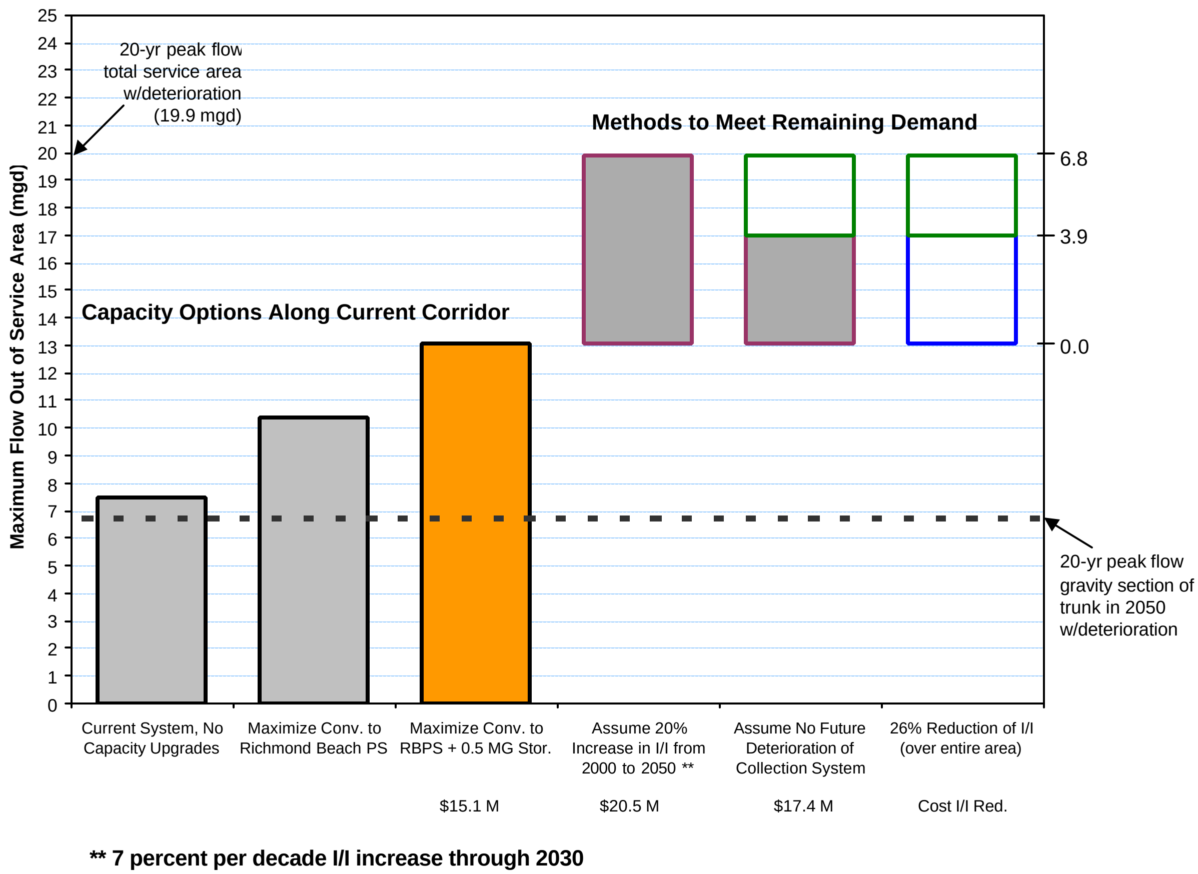

Figure 9. Distribution of costs for interim and future facilities upgrades in the Service Area

APPENDIX A: ENVIRONMENTAL ASSESSMENT OF ALTERNATIVES C AND D3

Alternative C involves intercepting wastewater at manhole B00-49 and pumping northward through a new force main and gravity sewer that intersects the Richmond Beach – Edmonds Interceptor at manhole 32A. Alternative D3 involves constructing a high flow bypass pressure sewer upstream of the Hidden Lake Pump Station that conveys wastewater along the shoreline to the Richmond Beach Pump Station.

The environmental impacts are based on published information in the following documents: the City of Shoreline's *Final Environmental Impact Statement, Volume1, Shoreview Park Capital Project* (1999); the City of Shoreline's *Parks, Open Space, and Recreation Services Plan* (1998); the City of Shoreline's *Draft Environmental Statement, Comprehensive Plan* (1997); King County's *Sensitive Areas Ordinance and Map Folio* (1990), and the *Puget Sound Environmental Atlas* (1987). Detailed field reconnaissance of the pipeline alignment has not been conducted for this report. Field verification would be necessary prior to final design.

Alternative C: Environmental and Construction Impacts and Permitting

<u>Existing Conditions</u>

Natural Environment

Topography and Soils: The Alternative C alignment would pass through one relatively steep slope area at the proposed gravity sewer location between 8th Avenue NW and 104th Avenue W along SW 244th Street. The topography drops approximately 80 feet over a distance of 200 feet, or roughly a 40 percent slope. The remainder of the pipeline alignment is located on a rolling plateau with a gentle north/south topographic orientation. Elevations in the area range from a low of 220 feet above mean sea level (MSL) where the proposed pipeline replacement will run between Algonquin Road and North Deer Road along Woodway Park Road, to a high elevation of 440 feet MSL along 8th Avenue NW.

Soils along the pipeline alignment are reportedly Alderwood series soils (City of Shoreline, 1997). Alderwood soils consist of a gravelly, sandy loam, and tend to have sufficient surface drainage. Everett series soils appear on the slopes leading down to Puget Sound and in the area of Boeing Creek. The Everett soils are similar to Alderwood soils (gravelly, sandy loam), except they are typically found below elevation 500 feet. However, because Everett soils are mostly coarse gravel and sand, they tend to drain rapidly.

Erosion Hazard: Erosion hazards are present within the project area, especially in the area of Boeing Creek. According to the *King County Sensitive Areas Ordinance and*

Map Folio (1990), an erosion hazard exists on the new pipeline route on the steep slopes along the SW 244th Street portion of the alignment (see Task 230, Figure 1). Additionally, the route from NW 180th Street to the Hidden Lake Pump Station is considered an erosion hazard area (King County, 1990).

Landslide Hazards: The only mapped landslide area within the study area lies north of the existing Hidden Lake Pump Station, along 10th Avenue NW (the Boeing Creek corridor) to N 175th Street. These areas are on a lower elevation compared to the adjacent bluffs along the Boeing Creek ravine.

Seismic Hazards: The pipeline alignment does not cross any mapped seismic hazard areas.

Hazardous Materials: Based upon documentary information (e.g., King County records), there is no evidence of significant quantities of hazardous materials within the project area. Some businesses in the project area, such as service stations, manufacturers, paint supply stores, etc., likely use and store hazardous materials. Because the majority of the pipeline route is through residential areas and because the area has historically been residential, the likelihood of encountering significant quantities of existing or historical hazardous materials is low.

Significant Vegetation: The City of Shoreline has identified significant areas of primary and secondary types of vegetation within the vicinity of the project alignment. Primary areas are areas of vegetation with little or no development that tend to occur in ravines, steep slopes, native growth easements, natural reserves, and parks. More widespread areas of secondary vegetation cover residential areas and large lots, with interspersed large tree stands. Existing mature vegetation is an important characteristic of the Richmond Beach/Innis Arden area.

The only designated significant areas of vegetation near the project alignment exist at Boeing Creek Park and adjoining Shoreview Park (City of Shoreline, 1998). However, the Alternative C alignment would not likely alter areas with designated significant vegetation. The proposed pipeline would pass entirely along roadway rights-of-way, except for a small portion of open space in southwest Snohomish County.

Water Features:

Surface Water Basins: The Alternative C alignment would lie within two surface drainage basins in King County. These basins include the Middle Puget Sound Basin (North) and the Boeing Creek Basin. Runoff generated along the proposed alignment in the Boeing Creek Basin flows either directly into Boeing Creek or Puget Sound. Runoff generated in the Middle Puget Sound Basin (North) discharges directly into Puget Sound.

Streams and Creeks: Boeing Creek, listed as a Class 2 stream, and its associated wetlands are the only surface waters near the proposed alignment, according to the *King County Wetland Inventory* (1991). The force main alignment would be located approximately 250 feet from Boeing Creek along 10th Avenue NW. Over the past 30 years, the area of the creek previously referred to as Hidden Lake, filled with silt and developed into a forested wetland. The King County Surface Water Management Division modified Hidden Lake, creating an open water wetland in 1998. The highly urbanized and relatively impervious nature of the Boeing Creek watershed has affected the water quantity and quality of the stream. High flow fluctuations have resulted in streambed scouring, stream bank erosion, and sediment deposition. Over the years, urbanization has increased the release of sediments and chemicals into Boeing Creek, thus degrading the habitat value.

Marine Shoreline: The only marine shoreline in proximity of the project area lies on the shore of Puget Sound. The *King County Map Folio* (1990) lists the entire shoreline as Class 1. Therefore it is listed and inventoried as a "Shoreline of the State" under the King County Shoreline Master Program and has a 100-foot shoreline buffer requirement. The Alternative C route would remain outside the 100-foot buffer zone established by King County.

Flood Hazard Areas: The proposed alignment route contains approximately 37 acres considered to be flood hazard areas, which are located in the Boeing Creek corridor. The proposed force main route along 10th Avenue NW lies within a 100-year floodplain (King County, 1990).

Wetlands: The only mapped wetland in the vicinity of the Alternative C alignment is the 2-acre Boeing Creek wetland, located approximately 250 feet from the proposed pipeline between the intersection of 10th Avenue SW and Innis Arden Way. This encompasses an area adjacent to the southwest corner of Shoreview Park. This wetland was significantly affected by a mudslide in 1997.

<u>Construction Impacts</u>

Traffic Impacts

Various arterials and streets would be affected by the construction of the proposed Alternative C pipeline. Local streets include 16th Avenue W, NW 167th Street, 10th Avenue NW and NW 185th Street. Collector arterials include NW 175th Street, 6th Avenue NW, 8th Avenue NW (from NW 185th Street to Richmond Beach Road), and Timber Lane. Minor arterials in the project area include 8th Avenue NW (north of Richmond Beach Road) and the Alternative C proposed alignment replacement sections of Woodway Park Road. The residential streets that would be affected include 104th Avenue W, 238th Street SW, and 239th Place SW.

Transit routes #304, #315, and #301 provide service from the City of Shoreline to downtown Seattle. Transit Routes #304 and #315 run along Richmond Beach Road and cross 8th Avenue NW. Transit Route # 301 travels along 8th Avenue NW from Richmond Beach Road north to the King/Snohomish County Line. The following three bus stops along this route would be temporarily altered by the proposed alignment: the stop between NW 205th Street and NW 197th Street, the stop near NW 193rd Street, and the stop near NW 190th Street.

The City of Shoreline's general policy regarding construction in roadways is to avoid road closures on designated arterials. The road closure policy on non-arterials is that signs and newspaper ads are required at least five days prior to the construction date.

Table A1 summarizes the roadways within the study area potentially affected by the Alternative C route.

Table A1. Roadways affected by the Alternative C proposed alignment.

Street Name	Type of Street	Speed Limit	Street Width (ft)	Potential Issues
16th Ave. West	Local Street	20	60	-Homes vary in distance from road, some are within 100 ft. -Many driveways have access to the road.
NW 167th St.	Local Street	20	60	-Residences vary in distance from road, some homes are within 100 feet of the road and visually unprotected from construction activities with no fences or large bushes.
10th Ave. NW	Local Street	25	60-40	-Large drop off to the south west of road. -Minimal shoulder width on both sides of the road. -The road becomes narrows to 40 ft. travelling toward Innis Arden Way, with a bridge ~250 ft. long that was recently retrofitted for earthquake protection by King County.
NW 175th St.	Collector Arterial	35	60	
6th Ave. NW	Collector Arterial	25	60-50	-The road at the intersection of NW 178th Pl. narrows to 50 ft. across.
NW 185th St.	Local Street	25	60	
8th Ave. NW	Collector Arterial (NW 175th St. to NW 180th St.) Minor Arterial (NW 180th St. to 205th St.)	35	60	-From NW 195th Street to the County Line, a drainage ditch lies to the east ~8 ft. from the edge line. -West of the road, homes reach as close as 20 ft. from the street boundary. -There is no paved sidewalk on either side of the road.
104th Ave. W	Residential Street	25	60-45	-Road narrows to 45 ft. for approximately 200 ft. along the road over a hump.
239th Pl. SW	Residential Street	25	60	-Alignment would run through residential neighborhood with homes set back over 100 ft. however, they all have driveways leading to the road.
Timber Lane	Minor Collector Arterial	25	60	-5 residences on the east side of the road are within 50-100 ft. of the road, with driveways leading to the right-of-way. -No shoulder on the west side.
238th St. SW	Residential Street	25	60	
Woodway Park Road	Minor Collector Arterial	25	60	

Within the City of Shoreline, local impacts to five streets would have to be taken into consideration with the implementation of the Alternative C alignment. Residences along 16th Avenue W, NW 167th Street, and 8th Avenue NW have homes that exist within 100 feet of the road. These adjacent properties also utilize driveways that have direct access to the impacted roads. Two streets along the proposed route contain sections where the roadway narrows. At the intersection of 6th Avenue NW and NW 178th Place, the road narrows to 50 feet. Along the 10th Avenue NW route, there exists a 250-foot bridge (approximately 50 feet wide) near the Innis Arden Way intersection. The proposed pipeline would either have to be channeled directly into the cliff, northwest of the bridge or be suspended underneath the bridge. Either possibility must consider the open water wetland to the southeast of 10th Avenue NW.

In the Town of Woodway, properties adjacent to Timber Lane have homes within 100 feet of the road. Furthermore, driveways would be impacted along 239th Place SW and Timber Lane that have access to the proposed pipeline route. Finally, a section of road along 104th Avenue W narrows to 45 feet in width near the King/Snohomish County Line.

Air

Construction of the conveyance pipeline would not be a major source of air quality degradation. The excavation phases would generate small quantities of particulate matter (fugitive dust). A majority of the proposed alignment runs along road rights-of-way surrounded on both sides by low-density residential homes (with the exception of commercial businesses that exist on a two-block portion of 8th Avenue NW, from NW 185th Street to NW 189th Street). Construction vehicles and heavy equipment would generate localized and temporary gasoline and diesel exhaust fumes, and dust on roadways, affecting the residences along the proposed pipeline corridor for a period of days.

Noise

Currently, traffic is the major source of noise to residents who live within the project area. On a short-term basis, residents along the project alignment would be impacted by noise from heavy construction equipment. This increase would generally occur during daytime working hours. Noise impacts would be most noticeable to those receptors closest to the construction area and along roadways used for construction vehicles. The proposed alignment route occurs in roadway rights-of-way adjacent to high and low-density residents (with the exception of commercial businesses that exist on a two-block portion of 8th Avenue NW, from NW 185th Street to NW 189th Street).

Noise levels could reach as high as 90 decibels (dBA) for short periods of time within 50 feet from the noise source. This would directly affect those residents living along 16th Avenue W, NW 167th Street, 8th Avenue NW, and Timber Lane. Noise associated with clearing and excavation typically falls within the 84 to 88 dBA range. Trucks used to haul excavated fill would also temporarily increase noise along haul routes. Construction-related noise impacts would be localized and short-term.

Utilities

Most of the arterials where the construction would occur contain underground and aboveground utilities, including power, water, cable, phone, and natural gas. Coordination with local utility companies within the project area would be essential to ensure safe working conditions and minimize disruptions to service.

Permits

Table A2 lists permits that would be required to construct the Alternative C proposal.

Table A2. Alternative C permitting requirements

Jurisdiction	Permit	Trigger/Activity
City of Shoreline	Right-of-Way Use Permit	-Necessary for construction in city roadways. -The permit provides and requires a detailed checklist of permitting needs for the City of Shoreline including: a City of Shoreline Permit Application Form, Proof of License, Bonding and Insurance, Traffic Control Plan, a Site Plan, an Erosion and Sedimentation Control Plan, and other documentation the City may request.
	Sensitive Areas Review	-Construction in steep slope hazard area.

To perform construction in the City's right-of-way easements, the contractor must fulfill the requirements of the local right-of-way use permit. The permit requires completion of a detailed checklist of permitting needs for the City of Shoreline.

Shoreline requires a full-width overlay for all surface street restoration work. The contractor will typically be required to go a little beyond the jagged edge pavement cut near the trench for restoration. Various trenchless construction technologies are allowed and encouraged because they limit interference with traffic flow and can potentially reduce restoration costs. Construction of the new sanitary sewer along unpaved shoulders may be allowed, depending upon availability of space. Shoreline has no restrictions on allowable pipe materials.

Summary of Impacts and Permitting Requirements for Alternative C

The potentially most significant natural environment constraints to the Alternative C project would be construction along the Boeing Creek corridor along 10th Avenue NW due to the sensitive characteristics of the area. Best Management Practices (BMPs) would have to be incorporated into the construction plans near this area of the project to ensure no adverse impacts will occur to the natural habitat. These would include development of erosion and sediment control plans, sensitive areas review, less invasive construction methodologies, and restoration immediately after construction.

The most significant local construction impacts relate to traffic. Streets that will require the most coordination with local officials in the City of Shoreline are 16th Avenue W, NW 167th Street, 10th Avenue NW, 6th Avenue NW, and 8th Avenue NW. The Town of Woodway officials would be concerned with construction along 104th Avenue W, 239th Place SW, and Timber Lane.

Alternative D3: Environmental and Construction Impacts and Permitting

<u>Existing Conditions</u>

Natural Environment

Topography and Soil: The Alternative D3 alignment would pass through one relatively steep slope area just east of 16th Avenue NW, where the sewer pipeline runs east toward the beach. The slope in the area is approximately 180 feet over a distance of 500 feet, or roughly a 35 percent slope. The remainder of the pipeline alignment is located on a rolling plateau with a gentle north/south topographic orientation from the intersection of NW 175th Street and 10th Avenue NW to the end of 16th Avenue NW. Elevations in the area range from approximately sea level to a high of approximately 340 feet MSL along the 10th Avenue NW portion of the pipeline route.

Soils along the pipeline alignment are reportedly Alderwood series soils (City of Shoreline, 1997). Alderwood soils consist of a gravelly, sandy loam, and tend to have sufficient surface drainage. Everett series soils appear on the slopes leading down to Puget Sound and in the area of Boeing Creek. The Everett soils are similar to Alderwood soils (gravelly, sandy loam), except they are typically found below elevation 500 feet. However, because Everett soils are mostly coarse gravel and sand, they tend to drain rapidly.

Erosion Hazard: According to the *King County Sensitive Areas Ordinance and Map Folio* (1990), the only known erosion hazard exists from NW 175th Street to the Hidden Lake Pump Station (see Task 230, Figure 1).

Landslide Hazards: Landslide hazards are significant along the Alternative D3 alignment. A major portion of the proposed beach route, which parallels the BNSF railroad up to the intersection at Richmond Beach Drive NW and NW 194th Street, is considered a landslide hazard area (King County, 1990).

Seismic Hazards: Approximately 1.5 miles of the pipeline route along the Puget Sound shoreline is mapped as a seismic hazard area (King County, 1990).

Hazardous Materials: The *Puget Sound Environmental Atlas* (1987) has documented evidence of the following chemicals in the vicinity of the proposed pipeline alignment in Puget Sound: low molecular weight polycyclic aromatic hydrocarbons, high molecular weight polycyclic aromatic hydrocarbons, PCB's, arsenic, cadmium, copper, mercury, lead and zinc. Although these potential contaminants have been measured in the project area, further studies must be performed to determine the precise location and amounts of the materials along the pipeline alignment. Testing would be necessary to determine that sediments disturbed by construction would not adversely impact construction workers or the marine environment.

Significant Vegetation: The City of Shoreline has identified significant areas of primary and secondary types of vegetation within the vicinity of the project alignment. Primary areas are areas of vegetation with little or no development that tend to occur in ravines, steep slopes, native growth easements, natural reserves, and parks. More widespread areas of secondary vegetation cover residential areas and large lots, with interspersed large tree stands. Existing mature vegetation is an important characteristic of the Richmond Beach/Innis Arden area.

The only designated significant areas of vegetation near the project alignment exist at Boeing Creek Park and adjoining Shoreview Park (City of Shoreline, 1998). However, the Alternative D3 alignment would not likely alter areas with designated significant vegetation. The proposed pipeline would pass entirely along roadway rights-of-way, except for a small portion of open space in southwest Snohomish County.

Water Features

Surface Water Basins: The Alternative D3 alignment would lie within two surface drainage basins in King County. These basins include the Middle Puget Sound Basin (North) and the Boeing Creek Basin. Surface water in the project vicinity flows into either Boeing Creek or directly into Puget Sound.

Streams and Creeks: Boeing Creek, listed as a Class 2 stream, and its associated wetlands are the only surface waters near the proposed alignment according to the *King County Wetland Inventory* (1991). The force main alignment would be located approximately 250 feet from Boeing Creek along 10th Avenue NW. Over the past 30 years, the area of the creek previously referred to as Hidden Lake, filled with silt and developed into a forested wetland. The King County Surface Water Management Division modified Hidden Lake creating an open water wetland in 1998. The highly urbanized and relatively impervious nature of the Boeing Creek watershed has affected the water quantity and quality of the stream. High flow fluctuations have resulted in streambed scouring, streambank erosion, and sediment deposition. Over the years, urbanization has increased the release of sediments and chemicals into Boeing Creek, thus degrading the habitat value.

Marine Shoreline: The primary marine shoreline that would be affected by the Alternative D3 alignment would be the large estuarine system (mixture of salt and fresh water) of Puget Sound. The *King County Map Folio* (1990) lists the entire shoreline as Class 1, therefore, it is listed and inventoried as a “Shoreline of the State” under the King County Shoreline Master Program and has a 100-foot buffer requirement. Furthermore, Puget Sound provides habitat for the Chinook salmon (listed as “endangered” by the federal government under the Endangered Species Act) and the coho salmon. The Alternative D3 alignment would infringe upon the shoreline and the standard buffer.

According to the *Puget Sound Environmental Atlas* (1987) the proposed alignment passes through a significant amount of eelgrass beds in Puget Sound. Eelgrass beds are important for a number of species residing in Puget Sound. Large numbers of invertebrate species live either in the organic-rich sediments trapped by eelgrass, on eelgrass blades. Birds, a low tide, and fish such as salmon and flatfish forage in eelgrass beds.

Construction of the proposed pipeline route would impact the shoreline, which is mapped as a shellfish resource for Dungeness crab. In addition, this Puget Sound shoreline area is designated as a tribal usual and accustomed fishing place for the Muckleshoot, Suquamish, and Tulalip Tribes (*Puget Sound Environmental Atlas*, 1987).

<u>Flood Hazard Areas</u>: According to the *King County Sensitive Areas Ordinance and Map Folio* (1990), the proposed alignment would remain outside mapped flood plains. The Hidden Lake Pump Station is located in a 100-year floodplain. However, the diversion pump station would be constructed approximately 250 feet from the floodplain.

<u>Wetlands</u>: The only mapped wetland in the vicinity of the Alternative D3 alignment is the 2-acre Boeing Creek wetland, located approximately 250 feet from the proposed pipeline between the intersection of 10th Avenue SW and Innis Arden Way. This encompasses an area adjacent to the southwest corner of Shoreview Park. This wetland was significantly affected by a mudslide in 1997.

<u>Construction Impacts</u>

Marine Impacts

As mentioned above, numerous impacts to the shoreline of Puget Sound would have to be addressed with the implementation of the Alternative D3 alignment. Impacts to the Puget Sound wildlife, vegetation, and tribal agreements would have to be taken into consideration with the development of a plan for the Alternative D3 proposed alignment.

If the pipeline were installed in Puget Sound, there would be no appropriate way to flush accumulated solids from the flat portion of the pipeline constructed near the beach. It is possible that this pipeline section would produce noticeable odors on the beach during the summer months.

Traffic Impacts

Construction of the Alternative D3 route would only impact a few roads. Construction would affect the local streets of 10th Avenue NW (from NW 175th Street to NW Innis Arden Way), NW 167th Street (from Innis Arden Way to 15th Avenue NW), and 16th Avenue NW (from 15th Avenue NW to the road's dead end).

Table A3 summarizes the roadways within the study area potentially affected by the Alternative D3 route:

Table A3. Roadways affected by the Alternative D3 proposed alignment.

Street Name	Type of Street	Speed Limit	Street Width (ft)	Potential Issues
16th Ave. West	Local Street	20	60	-Homes vary in distance from road, some are within 100 ft. -Many driveways have access to the road.
NW 167th St.	Local Street	20	60	-Residences vary in distance from road, some homes are within 100 feet of the road and visually unprotected from construction activities with no fences or large bushes.
10th Ave. NW	Local Street	25	60-40	-Large drop off to the south west of road. -Minimal shoulder width on both sides of the road. -The road narrows to 40 ft. travelling toward Innis Arden Way, with a bridge ~250 ft. long that was recently retrofitted for earthquake protection by King County.

Construction planning along the Alternative D3 alignment must consider impacts to three roads. Some residences along 16th Avenue W and NW 167th Street lie within 100 feet of the road. These adjacent properties also utilize driveways that have direct access to the impacted roads. A 250 foot-long bridge (approximately 50 feet wide) is located along 10th Avenue NW, near the Innis Arden Way intersection. The proposed pipeline would either have to be constructed into the cliff, parallel to the bridge or be suspended beneath the bridge. The open water wetland to the southeast of 10th Avenue NW would have to be considered.

Air

Construction of the conveyance system pipeline would not be a major source of air quality degradation. The excavation phases would generate small quantities of particulate matter (fugitive dust). A majority of the proposed alignment runs along the Puget Sound shoreline, except along the road rights-of-way where low-density residential homes exist. The impacts of the dust would be localized and temporary, affecting the residences that align the proposed pipeline corridor for a period of days (depending upon construction plans at each section of the pipeline). Construction vehicles and heavy equipment would generate gasoline and diesel exhaust fumes and dust on roadways. These impacts would be localized and short-term.

Noise

Currently, the major sources of noise affecting residents and visitors to the project area include traffic, trains along the Burlington Northern Santa Fe (BNSF) railroad, and the waves from Puget Sound. On a short-term basis, noise from heavy construction equipment would be generated at construction sites along the project alignment. Noise levels could reach as high as 90 decibels (dBA) for short periods of time within 50 feet from the noise source. This would directly impact those residents living along 16th Avenue NW and 167th Street NW. Noise associated with clearing and excavation typically falls within the 84 to 88 dBA range. Trucks used to haul excavated fill would also temporarily increase noise along haul routes. Construction-related noise impacts would be localized and short-term. In addition, construction activities would be limited to daytime hours.

Utilities

Most of the arterials where the construction would occur contain underground and aboveground utilities, including power, water, cable, phone, and natural gas. Coordination with local utility companies within the project area would be essential to ensure safe working conditions and minimize disruptions to service.

No utilities are known to exist along the shoreline of Puget Sound.

Permits

Table A4 below lists permits or reviews that may be required in order to construct Alternative D3.

To perform construction in the City's right-of-way easements, the contractor must fulfill the requirements of the local right-of-way use permit. The permit requires completion of a detailed checklist of permitting needs for the City of Shoreline.

Shoreline requires a full-width overlay for all surface street restoration work. The contractor will typically be required to go a little beyond the jagged edge pavement cut near the trench for restoration. Various trenchless construction technologies are allowed and encouraged because they limit interference with traffic flow and can potentially reduce restoration costs. Construction of the new sanitary sewer along unpaved shoulders may be allowed, depending upon availability of space. Shoreline has no restrictions on allowable pipe materials.

Table A4. Alternative D3 permitting requirements

Jurisdiction	Environmental Review/ Permit	Trigger/Activity
US Army Corps of Engineers	Individual 404	-Discharge of dredged and fill material into a waterway
	Section 10	-Any work in or affecting navigable waters of U.S. (e.g., piers, floats, outfalls, dredging, etc.)
	Biological Assessment[a]	-Any work done in potential Endangered/ Threatened species habitat.
Washington State	State Environmental Policy Act (SEPA) review	-Process is integrated with activities to ensure that planning and decisions reflect environmental values and seeks to resolve potential problems.
WA State Department of Ecology	Coastal Zone Management Consistency (CZM)	-Required for Corps authorized projects. -Ecology reviews for CZM consistency
	Water Quality Certification (WQC)	-Federal permits to conduct any activity that may result in a discharge of dredge or fill material into water or wetlands
WA State Dept. of Fish & Wildlife	Hydraulic Project Approval (HPA)	-Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters
Burlington Northern Santa Fe Railroad	Utility License Agreement	-Work that will occur within the BNSF right-of-way
City of Shoreline	Right-of-Way Use Permit	-Necessary for construction in city roadways. -The permit provides and requires a detailed checklist of permitting needs for the City of Shoreline including: a City of Shoreline Permit Application Form, Proof of License, Bonding and Insurance, a Traffic Control Plan, a Site Plan, an Erosion and Sedimentation Control Plan, and other documentation the City may request.
	Sensitive Areas Review	-Construction in steep slope hazard area, along shoreline.
	Shoreline Conditional Use	-Construction in a shoreline area.

[a:] Washington State agencies would also require a biological assessment.

<u>Summary of Impacts and Permitting Requirements for Alternative D3</u>

The most significant natural environment constraints to the construction of the Alternative D3 alignment would be construction in Puget Sound and along the Boeing Creek corridor. Construction along Puget Sound would require significant environmental analyses and permitting. A biological assessment would be necessary for compliance with the Endangered Species Act. To implement the Alternative D3 alignment, extensive coordination with permitting agencies and BNSF would have to be performed, and significant mitigation measures would likely be required. Furthermore, coordination with local officials from the City of Shoreline would be necessary to address the impacts to 16th Avenue NW, NW 167th Street, 10th Avenue NW, and 10th Avenue NW.

King County personnel asked the CSI project team to investigate if there would be cost and permitting benefits with construction timed to coincide with Sound Transit track work in the area. Discussions with Sound Transit personnel revealed that there are already two railroad tracks at the bottom on the bluffs at the west edge of the Service Area. Sound Transit does not plan on adding an additional track in the Service Area. (Additional track will be laid in Snohomish County where there is only one rail line.) Therefore, there would not be an opportunity for coincident construction, and the responsibility for obtaining all the necessary permits mentioned above would be shouldered by KC WTD.

APPENDIX B: SUMMARY OF HIDDEN LAKE DECISION WORKSHOP

MEMORANDUM

TO: Bob Peterson – King County
Jim Peterson – HDR

FROM: Lori Jones – Brown and Caldwell
Tony Dubin – Brown and Caldwell

SUBJECT: Summary of Hidden Lake Decision Workshop – March 16, 2000

On March 16, 2000, the CSI project team met with several King County staff at the King Street Center to discuss the progress to date on Conveyance System Improvement planning for the Hidden Lake – Richmond Beach service area (see Appendix B.1 for attendees list; Appendix C for the presentation slides). The objective of the workshop was to reach a consensus on a program that would meet the immediate upgrade needs at the Hidden Lake Pump Station, reduce the number of sanitary overflows in the service area, and achieve the RWSP 20-year control level. The workshop began with Jack Warburton of BC describing the current conveyance problems in the service area. These include:

- The Hidden Lake Pump Station wet well and the weir at Boeing Creek Trunk manhole 7A each overflow approximately 3 to 5 times per year[16]. Some of these discharges result in untreated discharges to Puget Sound.
- The Boeing Creek Trunk manholes B00-2, B00-3, B00-4, B00-7, B00-8 and B00-9 have experienced surcharging; manholes B00-22 and B00-29 have overflowed. (See Appendix C, slide 3)
- The Hidden Lake Pump Station has documented operational problems. The station is almost 40 years old and requires substantial electrical, instrumentation and mechanical updates. A critical issue is that the current wet well has very little capacity to manage current 20-year peak flows.
- The limited capacity of the Boeing Creek Trunk has resulted in backups into local sewers. Previous sliplining reduced conveyance capacity along sections of the pipeline, and Shoreline WMD links the sliplining to some of the problems experienced by their customers.

[16] This estimate includes both storm-related overflows and mechanical failures resulting in overflows.

- Capacity restrictions along the Boeing Creek Trunk prevent the full capacity of the Richmond Beach Pump Station from being used. Even when overflows are occurring upstream, the peak flow at Richmond Beach typically ranges from 7 to 7.5 mgd. The station has a peak capacity of 10.4 mgd.

The discussion of current configuration and identified problems was followed by a summary of the service area flow projections relative to the capacity of the existing facilities. The projected 20-year peak flow is higher than the capacity of all King County facilities tributary to Richmond Beach (see Appendix C, slide 7). It was noted that peak flows in the service area are composed largely of I/I (see Appendix C, slide 8). Approximately 88 percent of the projected peak flow of 19.9 mgd in 2050 (assuming 7% per decade increase in I/I for 3 decades) would be due to I/I. The population and employment growth rate in the service area is small; planning for future wastewater needs is driven largely by I/I concerns. There was some discussion about the impacts of sewer deterioration on I/I rates. Gunars Sreibers and Marcos Lopez both noted that minimizing the effect of sewer aging on I/I rates is a goal of the I/I program.

After reviewing the system alternatives that were developed in earlier CSI work, some additional alternatives emerged by combining the following elements:

- Increasing the conveyance capacity along the current corridor
- Incorporating storage to attenuate peak flows
- Managing demand by reducing I/I or reducing the amount of sewer deterioration
- Constructing a pump station and diversion sewer to carry peak flows away from the Boeing Creek Trunk

In all alternatives, it was assumed that reconstructing the Hidden Lake Pump Station is a high priority and would occur at the beginning of the program. In other cases, it was assumed some of the work would be performed immediately and the rest would coincide with the results of the North Plant siting project and the Regional I/I study.

Two promising Hidden Lake system scenarios were presented (see Appendix C, slide 22):

A. Rebuild Hidden Lake Pump Station immediately, make spot improvements to Boeing Creek Trunk, and monitor and respond to overflows. When the results of the I/I program become available (assumed 2005), construct a diversion pump station and pipeline large enough to meet the RSWP standard of one overflow per 20 years; or,

B. Rebuild Hidden Lake Pump Station at 5.5 mgd, and expand capacity along sections of the Boeing Creek Trunk in order to utilize full capacity of the Richmond Beach Pump Station, providing conveyance for the 2-year peak flow. One half million gallons (0.5 MG) of storage could be added upstream to increase the control level to the 4 or 5-year peak flow. When the results of the I/I program are available, control could be brought to the 20-year level through a combination of additional storage and I/I reduction, or other facility improvements.

Christie True suggested that option B would provide immediate relieve for local customers, demonstrate the County's strong desire to reduce overflows and allow time for the Regional I/I program to work. She felt the benefits of reducing the number of overflows quickly more than outweighed the estimated 10 to 15 percent additional cost of option B. Mike Fischer stated that overflows are unacceptable and every effort should be made to limit overflows immediately, and as such was in favor of option B. Shirley Marroquin described possible ESA and HCP concerns related to overflows and stated that KC would be sending the wrong message with a program that would not reduce the number of overflows until several years into the future. Shirley also acknowledged that option A would demonstrate a *business-as-usual approach* by accepting and conveying all flows from the local agency while running counter to the goals of the Regional I/I program; this was echoed by others. Roger Browne also expressed his preference for option B.

In conclusion, there was a strong consensus that option B would be the best course of action. The attendees felt this option would provide the best balance of immediate SSO reduction, coordination with the Regional I/I and North Plant siting projects, and limiting capital and O&M costs. It was also acknowledged that King County, particularly through the Regional I/I program, should make data collection within the service area a priority, specifically in the area downstream of the Hidden Lake Pump Station, which drains to the gravity portion of the Boeing Creek Trunk. Additional monitoring within the service area coupled with improved 20-year peak flow projections should be completed prior to final facilities design.

Action Item:

The Hidden Lake CSI project team will complete the final draft of the Hidden Lake Task 250 report incorporating direction from the workshop. This report will also include a more detailed description of the addition of storage upstream of the Hidden Lake Pump Station to help alleviate the problem due to the under capacity of the wet well and, based on the workshop discussion, will identify specific elements to be investigated during predesign. The final Task 250 report and the summary Task 260 will be included with the pending formal transfer of this project to the CIP program.

APPENDIX B.1. DECISION WORKSHOP ATTENDANCE LIST

CSI Hidden Lake – Richmond Beach Basin Decision Workshop

Thursday March 16, 2000 at 10:00 a.m. on the 8^{th} Floor of the King County building

Meeting Attendees:

Bob Peterson – King County

Katherine McKee – King County

Ed Cox – King County

Bob Swarner – King County

Mark Lampard – King County

Roger Browne– King County

Marcos Lopez– King County

Dave Dittmar – King County

Calvin Locke – King County

Mike Fischer – King County

Gunars Sreibers – King County

Christie True – King County

Shirley Marroquin – King County

John Vaughn – King County

Peter Keum – King County

Dick Finger – King County

Jim Peterson – HDR

Sam Perry - HDR

Jack Warburton – Brown and Caldwell

Tony Dubin – Brown and Caldwell

Lori Jones – Brown and Caldwell

APPENDIX C: DECISION WORKSHOP PRESENTATION SLIDES